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WORLD PETROLEUM

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Front Cover — Carter Oil Co. wildcat which discovered the "Tensleep" at Elk Basin, Wyo. Photo by Rosskam, Standard Oil Co. (N. J.)

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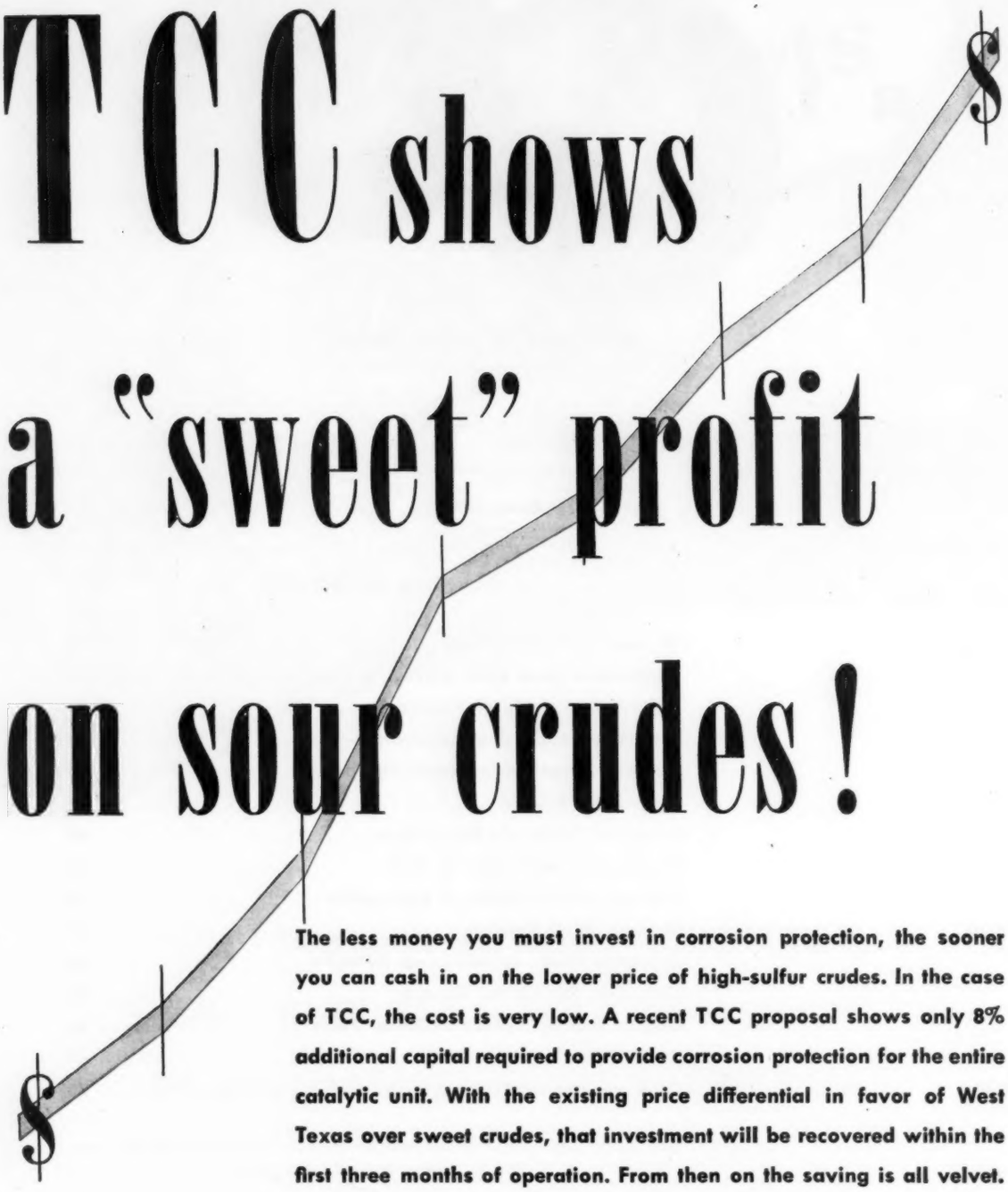

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EDITORIAL

OIL INDUSTRY'S SOLID FRONT

WHILE there are differences of views and opinions on many subjects among members of the American petroleum industry, there is one position on which virtual unanimity prevails. That is opposition to federal control or any form of centralized direction of the industry's operations. During the war just ended, to be sure, the oil men of the country accepted without question the imposition of complete governmental dictation and submitted obediently to directives which in many instances disrupted their normal business practices. This, however, was merely the recognition which all patriotic citizens gave to the existence of an emergency that called for the fusing of the nation's human and material power into a single unit of irresistible strength. It was the voluntary fulfillment of a clearly accepted duty. The task was brilliantly performed and skillfully directed but there was nothing in the successful record of the Petroleum Administration for War that won greater applause than its prompt dissolution once the necessity for its existence had passed.

Belief which found expression here and there that experience in working under unified direction during the war period would lead to a desire for retention of some of its features proved to be entirely unfounded. The ease and speed with which the industry returned to its former competitive activity astonished visitors from other lands. The old slogans extolling the advantages of individual brands of products promptly reappeared and companies vied with one another to prove that their developments during the war enabled them to provide better service than before to their customers. If anything the enforced suspension of certain phases of competition seemed to strengthen confidence in the system as a whole.

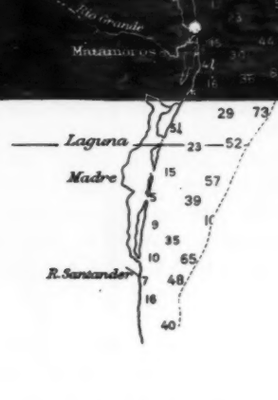
Within the past month two striking illustrations have been given of the unanimity of the industry in opposing any extension of federal authority and of keeping necessary regulation as fully localized as possible. One of these found expression in the strong dissent registered to the proposal of the Federal Power Commission to extend its authority over the production and end use of natural gas. At the hearing on this question held in Texas at the end of January the Governor of that state, pointing out that by far the larger part of the country's known gas reserves were contained within its borders, declared: "It cannot be expected that we will quietly submit to federal control over producing, gathering and processing this valuable state resource. We believe that in this field the rights of Texas are paramount." And the statements of representative oil men strongly supported this position. As evidence of the efficiency of state conservation it was shown that in 1927 when the first gas line was laid in northern Texas 95 percent of gas produced was wasted by being blown into the air whereas in 1944, out of a production of 825 billion cubic feet only four billion or less than one-half of one percent was so dissipated. Throughout the testimony of the oil men ran the expressed fear that the plans of the Power Commission constituted a step in a persistent campaign by government bureaus to substitute federal control for that of the states in the administration of energy resources.

Similarly in hearings conducted in Washington on the controversy over the attempt of the national govment to assert its authority over drilling in tidelands the sentiment of the oil industry clearly supported the claim of the states to jurisdiction over such lands lying between high and low tide levels. Although this is primarily a dispute between the federal government and the few states likely to be affected, the majority of oil men without any direct financial interest in the question, have rallied to support of the states' position because of their feeling against any expansion of federal control.

Undoubtedly the same ingrained attitude of distrust toward every manifestation of national authority except in the field of interstate commerce which is specifically reserved to the central government is responsible for such opposition as still persists to ratification of the Anglo-American oil treaty. While this document has been amended from its original form specifically to meet objections raised by members of the oil industry and has been limited mainly to a declaration by each of the two signatories to respect the rights and concessions of the other's nationals and to extend to them equal privileges in their respective territories its critics see a lurking danger in its seemingly innocuous phrases. They maintain that like the original agreement, it is still intended as a stepping stone to the organization of a world conference to govern international trade in oil and insist that the existence of the treaty might serve to give added strength to an effort by such a world organization to regulate production, export or import by the United States through the authority conferred by a treaty which specifies that the operation of petroleum facilities and the distribution of petroleum within the United States shall not be hampered by restrictions inconsistent with the purposes of that agreement.

INCLUSION OF CONTINENTAL SHELF STIRS INTEREST IN SUBMARINE DRILLING

Embarking for the Morning "Tower". All Photographs with this Article Published through Courtesy of The Texas Company.

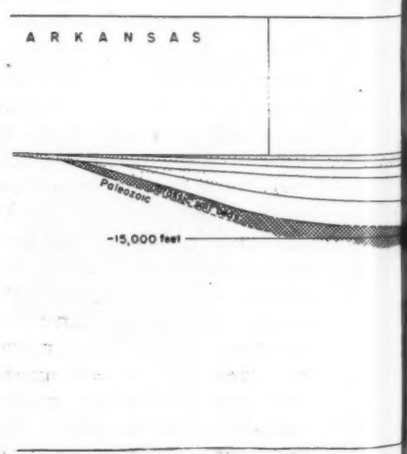


Geologists Agree That Prolific Fields Are Likely to be Found in Offshore Areas—Marine Drilling Presents Special Problems, Involves Higher Costs — Economic Factor Will Govern Progress in Development

EXPERIENCED geologists estimate the land area of the globe embracing conditions favorable to the existence of petroleum as 6,000,000 square miles. Potentially oil bearing areas in the United States are calculated as probably 1,000,000 square miles or approximately 15 percent of the total. This, of course, does not mean that all this area will be productive. Geologists do not discover oil. Their surveys only indicate where it may be found; the final test of its presence remains, as it always has been, the drill. Only 10 to 15 percent of the exploratory wells drilled in the past have yielded oil in commercial quantities; this may be regarded as a rough index of probable future results.

In the past the search for oil has been confined mainly to land areas. This is understandable because it obviously is easier to locate and recover petroleum when operating from a stable surface structure and because it has been possible up to the present time to find ample supplies through land operations. Geologists never have assumed, however, that deposits of oil stopped at the water's edge. From its very nature it is reasonable to assume that submarine deposits exist in many places and that large underwater fields may be found.

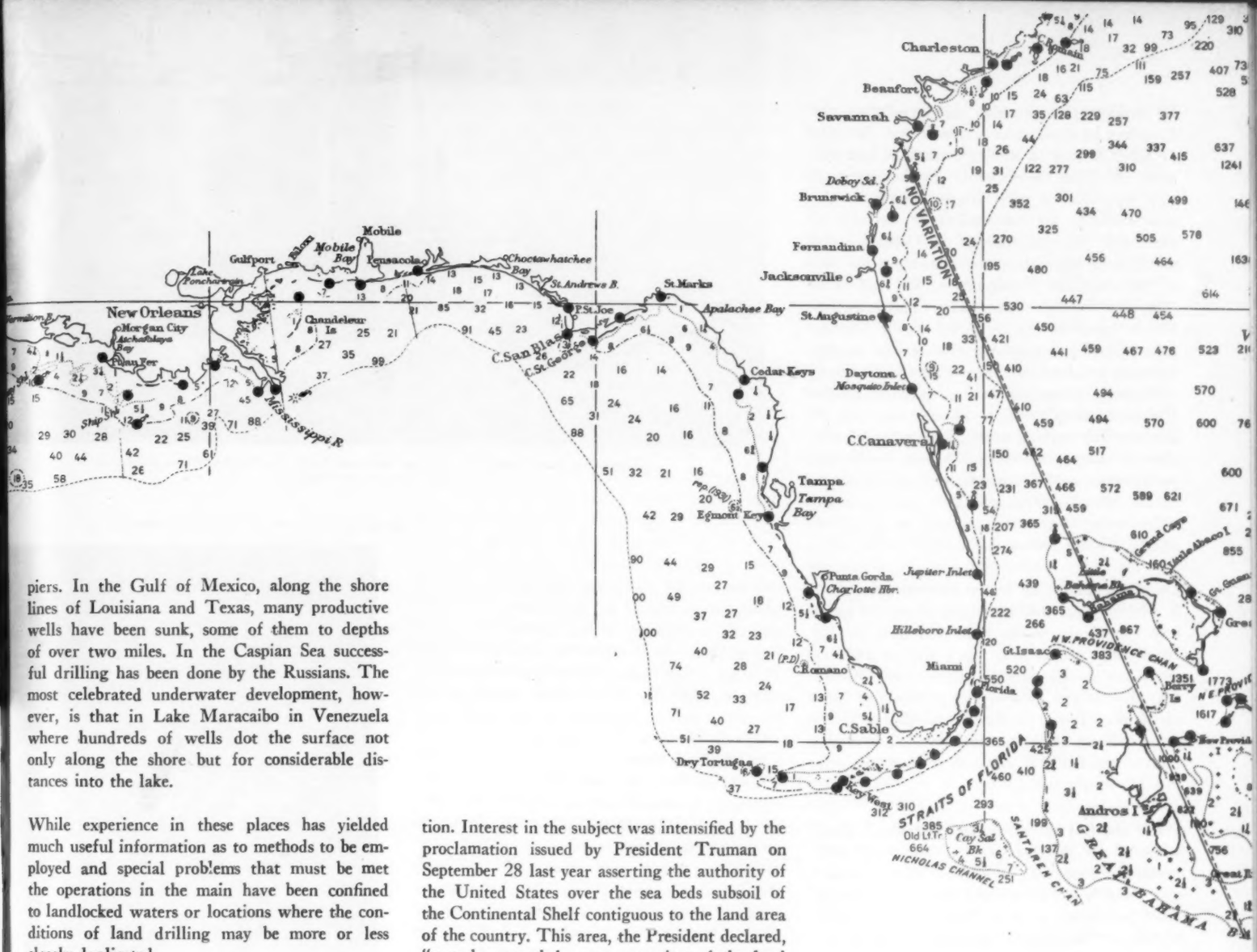
According to the generally accepted view, petroleum originated from organic matter deposited in marine sediments in ages past. It is found in marine sedimentary rocks formed from dust and slime deposited in inland or costal waters in geologic ages when large portions of the world's present land areas were submerged to greater or less depths. The great fields from which present supplies are drawn are in areas that were so inundated. Some of the most important of these fields occupy shore line areas today. The junction of land and sea is a line that has altered many times and still shifts at intervals. The same structures extend underneath land and sea. It is impossible not to believe that the same processes have produced the same results in both. As a matter of fact, underwater drilling has been carried on in various places for many years past. Along the California coast long piers have been run out from the shore and wells have been put down from derricks erected on these



piers. In the Gulf of Mexico, along the shore lines of Louisiana and Texas, many productive wells have been sunk, some of them to depths of over two miles. In the Caspian Sea successful drilling has been done by the Russians. The most celebrated underwater development, however, is that in Lake Maracaibo in Venezuela where hundreds of wells dot the surface not only along the shore but for considerable distances into the lake.

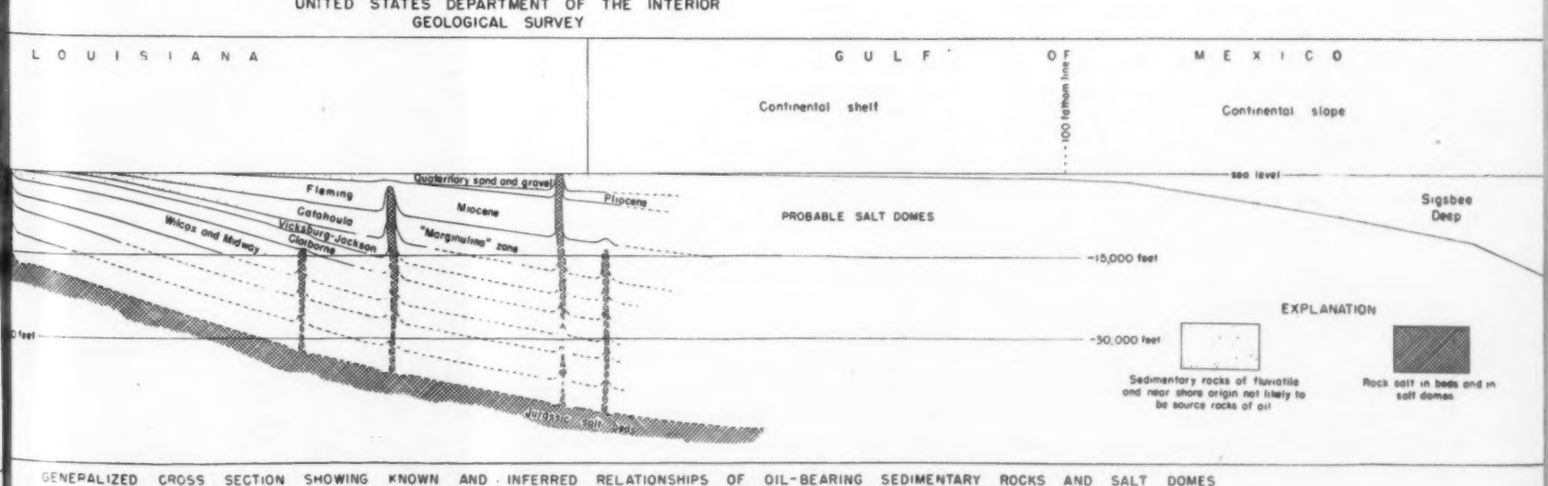
While experience in these places has yielded much useful information as to methods to be employed and special problems that must be met the operations in the main have been confined to landlocked waters or locations where the conditions of land drilling may be more or less closely duplicated.

As the discovery of productive fields by land surveys and drilling has come to require more extensive search and the fields discovered have been marked by lower potentialities operating men and technical experts have given increasing attention to the possibilities of submarine exploration. Interest in the subject was intensified by the proclamation issued by President Truman on September 28 last year asserting the authority of the United States over the sea beds subsoil of the Continental Shelf contiguous to the land area of the country. This area, the President declared, "may be regarded as an extension of the land mass of the coastal nation and thus naturally appurtenant to it". Its resources "frequently form a seaward extension of a pool or deposit lying within the territory and self-protection compels the coastal nation to keep close watch over activities off its shores which are of the nature necessary for utilization of these resources."



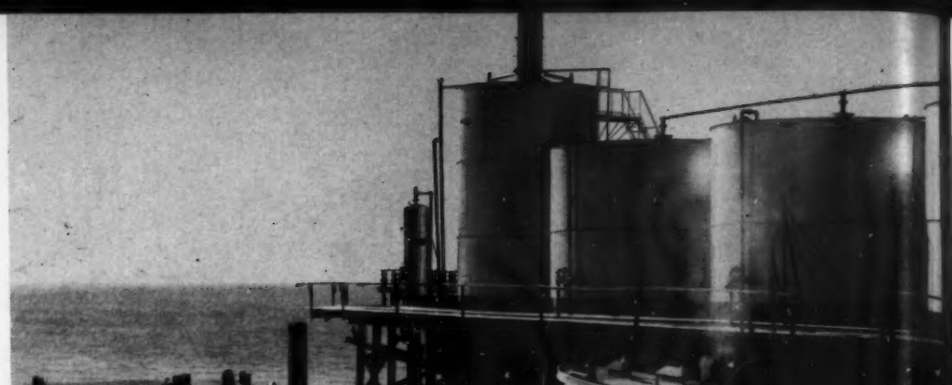
Map of Continental Shelf in the Gulf of Mexico and South Atlantic Area Showing Ocean Depths in Fathoms as Reported by the U. S. Hydrographic Office. Large Dots Indicate Location of Lights.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY



GENERALIZED CROSS SECTION SHOWING KNOWN AND INFERRED RELATIONSHIPS OF OIL-BEARING SEDIMENTARY ROCKS AND SALT DOMES OF GULF COASTAL PLAIN IN ARKANSAS AND LOUISIANA AND THEIR EXTENSION BENEATH THE CONTINENTAL SHELF

10 0 10 20 30 40 Miles



↑ Gathering Crude from Stock Tanks at Individual Wells Is a Problem Where Submarine Pipe Lines Are Not Feasible.

In making this assertion of jurisdiction the President by implication acknowledged the right of other nations to similar control of undersea areas adjoining their shores. In the aggregate this represents a very large addition to the area available for exploration. In the case of the United States a report of the Department of the Interior states that the submerged portions of the continent contiguous to its land mass comprises 750,000 square miles. This computation is based on the definition of the Continental Shelf as comprising all that area covered by water to a depth of not more than 100 fathoms (600 feet). According to maps prepared by the United States Geological Survey this strip is one of widely varying widths. Along the Atlantic Coast it ranges from 60 to 250 miles at different points between Maine and Cape Hatteras. South of the latter point it averages from 40 to 60 miles wide, the narrowest section being off Miami, Florida, where it is reduced to 20 miles.

On the western side of the continent the shelf is relatively narrow, averaging about 25 miles and varying in width from one mile to 50. In Alaskan waters it is much broader and extends for several hundred miles under Bering Sea. The largest area is that within the Gulf of Mexico. It has its greatest width off Texas and Louisiana and along the western side of the Florida peninsula. It amounts to approximately 149,000 square miles.

While the full extent of the Continental Shelf is equal to three-quarters of the land area counted as containing possibilities of oil production there is no expectation that more than a small proportion of it is likely ever to figure as part of the nation's petroleum resources or even to warrant exploratory tests under existing conditions. For purposes of classification off shore areas up to depths of 600 feet are included in the Continental Shelf but experienced oil men maintain that it is impractical to attempt the establishment of wells in water deeper than about 100 feet. At greater depths costs are held to be prohibitive with oil selling at or near its present level. Much of the Shelf region is in regions where conditions suggesting the possible presence of oil are entirely lacking or where exposure to storms or other unfavorable factors discourage exploratory efforts. Discounting all these conditions, however, there remain fairly extensive areas which in the light of present knowledge offer encouraging possibilities for exploration and prospective development. Perhaps the most inviting of these under existing conditions are to be found in the Gulf of Mexico.

President Truman's action in asserting American authority over exploration of the Continental Shelf was no hastily determined move. It came as the result of extensive studies by members of the geological survey and other branches of the Department of the Interior, extending over a long period. These surveys have included not only the measurement of waters surrounding the continental coast line but also studies of geological conditions in these underwater areas and the geophysical methods applicable in surveying them. In a report by Director W. E. Wrather of the Geological Survey, he points out that one difficulty in collecting geological information on the character of the land mass under the sea arises from the fact that the outwash of debris from the continent itself usually spreads out over the shelf. The surface of the shelf area is covered with sand, gravel and silt. It is known that there are valleys extending over the shelf similar to river valleys and ending in gorges and canyon-life openings through the margin of the shelf. Geologists disagree as to whether these were formed as river valleys or not. Speaking of conditions in various offshore areas he says:

"We know the section from the margin of the Gulf of Mexico back inland with great detail on account of the numerous wells that have been drilled there. The formations continue out to sea and there is every reason to assume they will continue very much the same under the shelf portion. The Continental Shelf along the Pacific Coast is a much narrower belt and there is only one area on it where oil has been found. It is on that part of the Coast which includes the Elwood field, the Wilmington field and Huntington Beach field. The formations from which that oil is derived are great thichnesses of Tertiary sediments that lie in cup-like basins. Most of these basins are quite deep and are limited in area, like a bowl filled up with sediment. Oil is derived from horizons in those bowls, on structures some of which extend outward on a tangent to the coast and under the sea.

"The old Summerland field was drilled years ago with the derricks built on piling and extended outward into the shallow water. Some oil has been obtained by directional drilling. Between the coast and the Channel Islands lying offshore, there is an intervening basin that is

↓ Approaching a Marine Location by Motor Launch.

far more than 100 fathoms deep. On the Channel Islands the Territory formations that carry an abundance of oil on the mainland are relatively thin. The best possibilities in California are confined to a limited area."

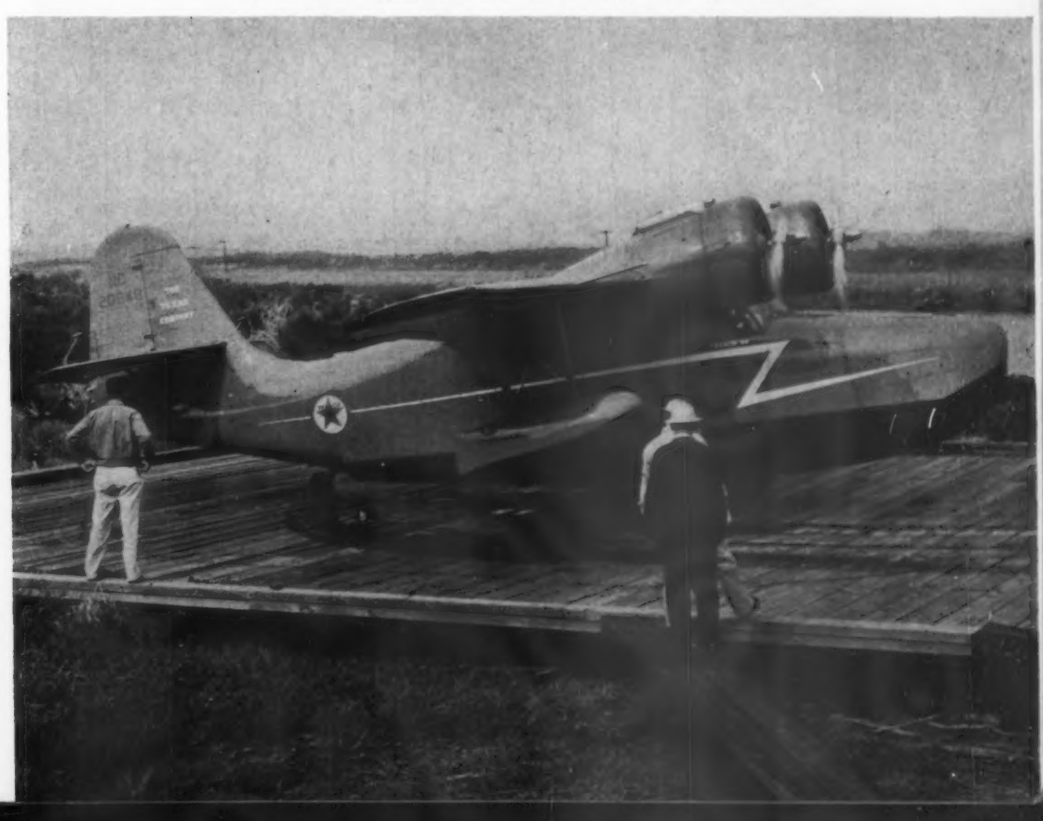
Referring to the Gulf Coast, he says: "The broad geologic relations suggest that salt plugs and suitable traps associated with them are present at least so far out on the submerged Continental Shelf off the Texas, Louisiana and Mississippi as submarine drilling is likely to be feasible in the predictable future, that this submerged area is underlain by potentially productive horizons of Miocene age, that part of it may be underlain by productive Pliocene horizons and that some production may be possible from deeper beds from horizons older than the Miocene. I think it is important to note the Pliocene beds. These beds are productive in relatively few fields. But farther underneath the Gulf, at greater depths, they contain more oil-bearing horizons. The deeper beds along the coast, of course, will soon get below the drillable depth.

"In the Gulf coastal region eastward from the salt dome basin, promising new oil production has been developed in recent years with the discovery of a few oil fields in Cretaceous sands in Mississippi and Alabama and oil has been discovered at a depth of more than 11,000 feet in wells drilled in the Everglades region of southern Florida. Development of these new areas has not yet advanced to the stage at which safe generalizations can be made about the possible mode of occurrence and the most useful techniques of discovery of any oil that may be present in the Continental Shelf area. In west central and southeastern Mississippi, the oil now known occurs chiefly in sands of Upper Cretaceous age. In southern Florida it is found in beds of probable Lower Cretaneous age beneath a very thick section consisting largely of limestone beds of Tertiary and Upper Cretaceous age. Although geophysical methods have been contributory to the location of these new areas and producing zones, such methods have been on the whole less effective than in the location of the more striking anomalies produced by salt domes. Nevertheless, the Continental Shelf along the west coast of Florida is exceptionally wide, exceeding 100 miles in width for the whole length of the peninsula, and systemative regional geophysical surveys of this extensive shelf area, which may include the eastern margin of the salt dome basin, might provide evidence of local anomalities indicative of crustal structural features.

"The gradually accumulating experience in drilling offshore wells in the Gulf Coast, in California, and in Lake Maracaibo, Venezuela, indicates that satisfactory drilling platforms of several types can be provided by engineers. Wooden piling foundations, submersible barges, rock-filled cofferdams, concrete-filled caissons, multileg foundations of concrete-filled sheet pile cylinders, and other types of foundation have been used. The cost of drilling per well at the Creole field has been greatly reduced by the directional control of wells, ten wells that explore an area nearly a mile square having been drilled from a single platform. Nevertheless, offshore drilling imposes large additional expense for protection from water pollution, damage to fisheries, wave action and abrasion, hurricane hazard and the creation of navigational hazards. The additional cost of producing and delivering the product to shore may make the development of fields far offshore in the Gulf unprofitable at present prices for petroleum."

A report by Dr. F. W. Lee of the Bureau of Mines deals with the application of geophysical methods to submarine surveys. "Underwater explorations have become possible only by the new geophysical exploratory methods," he says. "Only since these methods have advanced to a stage where it it possible, by their aid, to make the necessary underground examination has the mineral value of the Continental Shelf become an economic factor. Geophysical exploratory methods measure down through barriers with which the geologist cannot cope, and give an indication of the many buried features which control oil deposition and mineralization in such areas. Geology is usually restricted to two dimensions, the width and the length, as well as the

↓ The Texas Company Uses Seaplanes for Many Marine Operations.



need to examine the rock outcrops in question. Geophysics adds the third dimension - depth - and does not reply upon contact with rock outcrops.

"Fundamentally, there is little difference between geophysical prospecting on land and on offshore submerged land, generally referred to as the Continental Shelf. The information which is to be ascertained in both places is the same, and the nature of the oil accumulations are no different in the submerged areas from what they are in the land areas. Therefore, it is only necessary to use the same geophysical methods which have become standard, comprising magnetic, gravimetric, seismic, and chemical surveys.

"However, there is a very great difference between the application on land and on water of these methods and the technique of their execution, due partly to the great precision which is required, combined with the stability which is needed for making such observations. On land, firm foundations can be secured and leveling equipment can be easily adjusted. On water, this is not the case, and additional development of equipment and apparatus will be required before the same information can be obtained at sea.

"There is very little difficulty in marking the spot on land at which geophysical measurements have been made. The station locations, as well as the traverses on which such measurements are made, can easily be marked and laid out with surveyor's instruments, such as transits, alidades and so forth. Also, it is not very difficult to relocate these points.

"The sea markers are generally anchored to the bottom and indicate the relative position of a certain location rather than the absolute one. It will, therefore, be necessary to design sea markers which rest on the sea bottom so that exact location can be ascertained, as on land. While this problem is not difficult in shallow depths, it becomes more so deeper down. Situations of this type represent some of the fundamental problems relating to making such surveys of submerged areas.

"Other difficulties of equal importance are climatic, which are associated with waters in various parts of the continental shelves of the United States. It can be stated that the Gulf of Mexico generally has temperate water combined with relatively shallow depth and would offer the least difficulties from a climatic point of view. On the other hand, the Arctic Ocean areas of northern Alaska have low temperatures extending below freezing and handicap the execution of geophysical surveys. The roughness of the sea and the submerged topography are also of considerable importance because of the relative motions which they impart to geophysical measuring equipment.

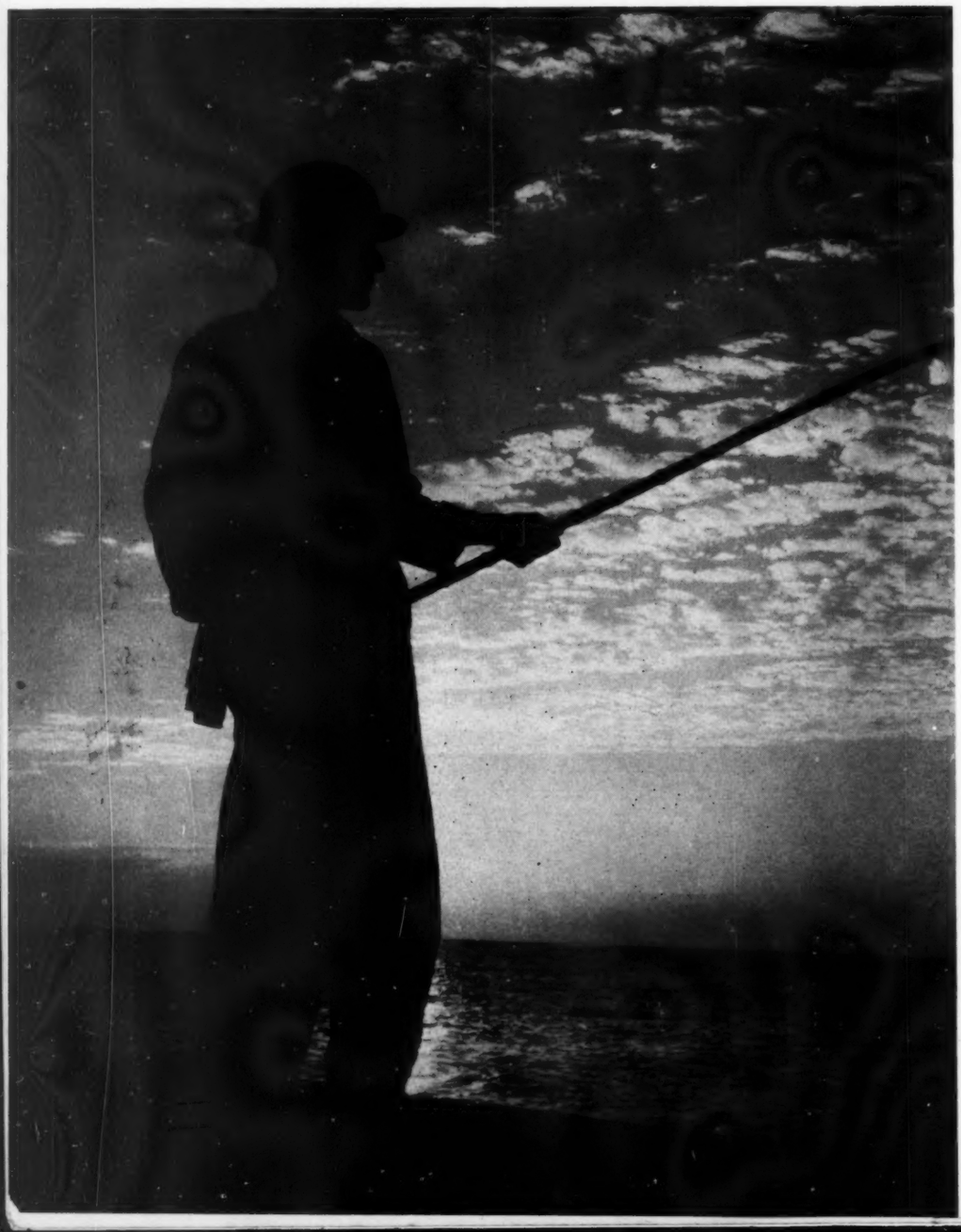
"While the above constitute some of the very obvious difficulties which have to be overcome, there exist many others which cannot be carefully planned for in advance, but must be overcome as they arise. For this reason, the standard geophysical equipment which is used on land must be altered to meet the conditions on sea and for this purpose there will be required sufficient laboratory and shop facilities for making tests and alterations.

"Magnetic methods, which are rapid and inexpensive, can map out in many areas buried mountains and valleys in the crystalline basement which may give rise to or are related to overlying sedimentary structures favorable for oil accumulations. Such surveys can be made by using an airplane, thereby covering large areas in a very short time. By making surveys at different elevations, it is possible to examine somewhat detailed anomalies at low elevation such as would be caused by dikes and other small geologic bodies. Larger regional trends can be measured at higher elevations. Such magnetic surveys would be useful for all parts of the Continental Shelf, particularly off the Alaskan and Atlantic coasts and the Gulf of Mexico.

"Probably the quickest direct return can be had in the Gulf of Mexico by seismic measurements over salt domes buried at depths not over 3,000 feet. For delineating such salt domes, refraction seismic methods prove satisfactory. For such measurements relatively simple equipment will suffice, with but slight alterations in the usual land equipment. Additional radio circuits will be required for making such observations on water, but these need not be very complicated.

"Relation seismic measurements will prove especially effective on the Arctic Ocean shelf, in the Gulf of Mexico and the Atlantic Ocean shelf. In areas where there is a large amount of faulting, as would be anticipated on the Pacific Coast, seismic results will be most difficult to interpret *** So far seeps have not been discovered in the Continental Shelf, although there is evidence of their presence

↓ Fishing from Location Has More Attraction Than the Lazy Bench for Followers of Isaac Walton.



from the oil slicks at certain locations. The tracing in sea water of minute amounts of oil for their origin is of value for locating oil deposits. There is also some evidence of increased salinity of the water at certain locations in the Gulf of Mexico. This increased salinity may possibly have its origin in buried salt domes, and if so, would offer a method of locating and identifying them."

As mentioned by Dr. Wrather special conditions have to be dealt with in drilling submarine areas and economic considerations arising from these conditions are likely to prove the main factor in limiting exploratory drilling on the Continental Shelf. It is essential for example to have firm and stable foundations in order to sustain the weight of the derrick, machinery and pipe used in drilling a submarine well. Therefore, the character and depth of the undersea floor is an important factor in determining the feasibility of drilling at a specific location. In places subject to hurricanes or heavy wave action both foundation and above surface structure must be capable of resisting such violent forces. In the hurricane districts of the Mexican Gulf and the Caribbean winds at times attain a velocity of 200 to 250 miles per hour and special alloy metals may be required to construct derricks capable of meeting their attacks.

There are also such practical problems as guarding against water pollution, damage to fisheries, creation of hazards to navigation, the handling of workers and supplies and the storage and movement of oil that may be produced to be taken into account in submarine drilling. All of these add to the cost of such operations and presumably will limit them to locations where the character of formations offers a fair prospect of uncovering a field of fairly large potentialities, at least until the price of oil is much higher than it is today.

In certain regions where large areas are covered by shallow waters, and particularly where accumulated knowledge of formations on the nearby mainland and their trend point to favorable conditions, the exploration of these portions of the Continental Shelf may very likely be undertaken by some of the large oil companies. While no declarations of such intention have been made affecting waters of the United States a number of companies have obtained concessions for exploration in and about the Bahamas and preliminary surveys are already under way. In Trinidad one such grant recently has been made. Should any of these early efforts be rewarded by the discovery of a prolific field it undoubtedly would provide a great stimulus for submarine drilling in other parts of the world.

Coastal States Fight Federal Ownership of Tide-Lands

BY WILLIAM J. MADDOX*

Attorneys General, port authority officers and other officials from more than a score of states followed one another on the witness stand before the Senate Judiciary Committee early in February in support of legislation whereby the federal government would quitclaim any title it might have to submerged lands. Robert W. Kenny, Attorney General of California, led off the presentation of the states with the charge that the dispute over state vs. federal ownership of the lands was "initiated by the unauthorized acts of the Secretary of the Interior in attempting to reverse not only his own decisions, but the long-settled decisions and policies of the federal government. It is an unprecedented attempt to centralize enormous power and billions of dollars worth of property rights in Washington at the expense of the states and their many grantees."

Defense of federal ownership to tidewater lands was made by Secretary of the Interior Harold Ickes, who held that the question was one for the courts to decide. He questioned the propriety of Congress enacting legislation to settle the controversy while the suit filed by the government seeking a decision on the matter is pending before the Supreme Court of the United States.

Kenny's testimony challenged this contention on the ground that "the idea which has been advanced that Congress should cease to function because a federal official has filed a suit in the courts totally misconstrues the constitutional processes under which congress is the law-making body, and the courts pass on the laws after they are made."

Kenny rejected the contention that oil is the paramount issue involved. "Those advocating this new centralization of power in Washington", he told the committee, "wish to make it appear that the present controversy pertains only to oil. For example, on June 20, 1945, Secretary Ickes wrote a letter to the House Judiciary Committee in opposition to H. J. Res. 225 in which he told the committee, 'The issue here is not one of states rights. It is oil — who owns and gets some of the specific valuable oil off the coast of California.'

"This statement was obviously calculated to lead all the other states to believe that their interests would not be jeopardized. However, the statement was untrue, even as to oil. For there are a number of other states which have valuable oil off their coasts and which would be affected if this transfer of power and ownership were accomplished.

"Shortly before that statement was made a suit was filed by Mr. Biddle (then U. S. Attorney General) at Mr. Ickes' request. In this suit it was asserted that the federal government owned fee title to certain lands off the coast of California. This was a claim which obviously affected every coastal state. Mr. Biddle frankly said that the case was intended as a test case. Mr. Biddle also stated publicly that as a result of this suit the titles of the inland states to the beds of their navigable waters would, as he put it, be clarified. Obviously, if your title is clarified, it is going to be affected one way or the other. On its face, therefore, it is clear that Mr. Ickes' statement to the house committee, whether knowingly or not, was false and misleading. There was a great deal more at stake than some specific oil off the coast of California.

"This first suit has now been dismissed and a new suit filed directly with the Supreme Court. The claim in this new suit is not limited to specific oil, or any oil, but the bold assertion is made by the United States Attorney General that no coastal state, not even the original thirteen, ever owned any of the land along the seacost and within the three-mile limit.

"Presently a further attempt is being made to quiet our fears and those of the port and harbor authorities and the inland states by the assertion that in the present suit no claim is made to lands beneath bays, harbors or inland waters. However, our sober judgment is that the suit is a threat to all bays, harbors and inland waters.

"Never before in history has any legal or factual distinction been made between lands lying off the coast within the three-mile limit and lands within bays and harbors. They are all held under the same legal doctrine. If the federal government is successful in destroying the legal basis of our title to one square foot of tide or submerged lands within the boundaries of our states, it will automatically follow that title to all ports and harbors and all filled and reclaimed lands everywhere will, to say the least, be under a very serious cloud."

In the last six years, Kenny told the committee, there have been several attempts on the part of federal officials to assert title to lands within bays and harbors, and to filled and reclaimed lands He cited the suit in 1941 to condemn 333

* Chief of World Petroleum Washington Bureau

acres on Terminal Island in Los Angles and Long Beach harbors, and the suit in 1943 to condemn Treasure Island in San Francisco Bay.

"This land was all upland, but the allegation of the government was that the government already owned it because it was filled tidelands." Kenny continued:

"If the government can take Treasure Island or Terminal Island because they are filled and reclaimed tidelands, it could, by the same token, take filled lands in any harbor or city in the country. If, as is now claimed, it never entered their minds to seize land within bays and harbors, why did they make these assertions within the last few years? And are we justified in relying upon their present statements that they have no designs to lands within bays, harbors, and beneath inland waters?"

The secretary of Interior outlined for the benefit of the committee a program which he thought should be enacted by Congress if the Supreme Court decides that the United States and not California owns the submerged lands. In such an event, he declared, there would be "appropriate occasion for relief legislation." He said the issue of ownership had never been clear, and he does not believe that anyone should be penalized for good-faith reliance upon the state's "claim to ownership".

According to one provision of Ickes' relief program, the states concerned and those who have operated under state laws should be relieved from any liability for damage in trespass for any past development of the submerged land. Specifically neither should be required to account for oil or gas extracted before the date of the decision of the Supreme Court. Leases and contracts for operations on submerged lands outstanding when the present suit was filed in the Supreme Court should be continued in force and effect by the federal government, at least as to royalty rate and time limit.

Structure, such as docks or piers, which have been erected on the submerged lands and the surface ownership of filled-in areas should not be disturbed if they were erected or filled in accordance with the federal or state law.

In addition, Ickes laid down a five-point policy of conservation for the tidelands, if they become government-owned, to be enacted by Congress.

1. These lands should be held as a federal oil reserve. Their administration should be coordinated with that of other federal oil reserves.

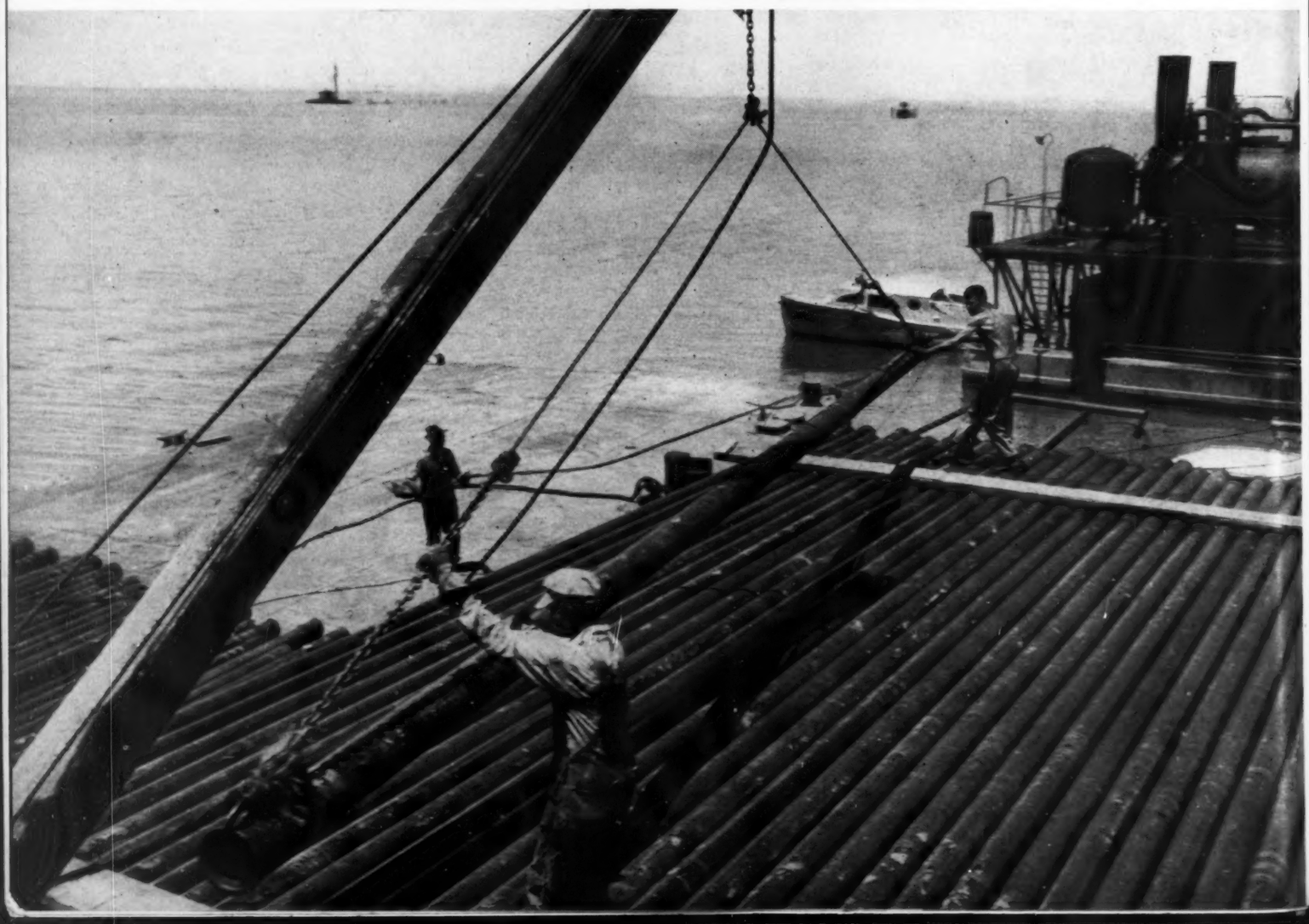
2. The lands should be explored geologically and geophysically by the Department of the Interior to determine the location and extent of possible oil and gas-producing structures. Methods and plans should be provided for the development of such structures against the event of emergency needs.

3. Authority should be given the Secretary of the Interior to permit him to exchange or acquire lands, and to lease and permit development when drainage of oil and gas from the submerged lands occurs or is threatened by onshore operations on adjoining lands.

4. When such lands are leased, because of the drainage which would otherwise occur, operations on the submerged lands should be coordinated with the onshore operations, so as to avoid competitive development and consequent wasteful practices. Such coordination should be accomplished readily where the adjoining states have adopted or would adopt and therefore adequate legislation for the regulation of production; otherwise unit agreement with the adjacent operators should be negotiated.

5. The interests of navigation should be protected in connection with any leasing or submerged lands. This would involve coordinated action by the War and Interior Departments. In view of the importance of recreation in some of the areas, interference with seashore recreational facilities should be avoided.

↓ All Equipment and Supplies for Drilling Wells Must Be Brought in by Barge.



TRENDS in Geophysical Exploration

BY JOHN F. ANDERSON*

WAR-TIME expansion of the search for new oil reserves resulted in a near universal recognition of the importance of geophysical exploration. The geophysical fraternity spread itself thin in an effort to meet the emergency but expansion was ultimately limited by the inability to obtain adequate technical personnel, instruments and mechanical equipment. Maximum utilization of available interpretative personnel resulted in more effective integration of geophysical and geological exploration. This is desirable and should survive the present transition period. A study of oil exploration during and since the war discloses definite trends in the use of geophysical methods, in the organization and operation of exploration departments and companies, and in research and development of instruments and equipment.

Without exception, major oil companies expanded their use of the seismograph during the past four years. Seismic exploration was at a peak in the middle of 1945 and was limited only by the lack of available contract crews. The tremendous amount of continuous and diagnostic subsurface information obtained by this method during the period as compared to that supplied by the expanded drilling program resulted in a general acceptance by production executives and geologists of the method as a necessary adjunct to every exploration program in the areas in which it is applicable. The drilling up of marginal seismic prospects has demonstrated the effectiveness of this method in exploring for low relief structures.

Many of the smaller oil companies have employed experienced geophysicists to direct and coordinate their geophysical exploration programs. The major portion of these men were formerly major oil company seismograph party chiefs and supervisors. They have been a great factor in the success of the smaller company exploration work in recent years.

The number of geophysical service contract companies has increased by an approximate factor of three during the past four years. Unlimited business during the period induced geophysicists to leave larger organizations for the chance to succeed on their own. They have purchased high quality equipment. Their survival will depend in part on the extent to which the larger contractors shift operations to foreign fields. American companies are preparing to do the major part of foreign contract geophysical surveying.

The seismologists' accumulated experience in special-problem shooting is beginning to assume an important role in exploration which cannot be successfully or economically done by ordinary methods. Exploration of marsh and swamp lands and inland and costal tide waters has become relatively routine to many seismograph organizations. For those who lack experience in such surveying it is still a practically impossible task. The deep flank exploration and exploitation of many producing salt domes is being materially expedited by the special types of reflection and refraction detail shooting that have been developed. Relatively accurate fault delineation by extreme detail shooting is not unusual.

There is a pronounced tendency among progressive major company geologists to supplement regional subsurface studies with occasional detail reflection profiles projected from points of known data into or across areas of little or no data via the lines of least mechanical resistance. Such reconnaissance work, when conducted by crews engaged in normal reflection detail operations in the vicinity, is a source of relatively inexpensive but invaluable regional information. Long range continuous seismic reflection and refraction programs are now being conducted by major companies in provinces where difficulties heretofore have discouraged use of the method.

Smaller oil companies have expanded their use of the seismograph in recent years and have generally acquired a minimum staff of geophysicists to supervise and coordinate these operations. In order to maintain continuous exploration during the war years several of these companies developed their own field crews or purchased outright one of the many one-or two-crew war-born contract companies. Although many independent producers could not afford the long term contracts preferred by seismic contractors, several did employ one crew continuously for a year or more during the war. Short-term service to these operators was provided in several local areas by small seismic contractors. Much work done by independents during the period of intense drilling was predicated on their ability to sell or trade acreage over small subsurface closures authenticated by seismic data.

A noticeable trend has been recognition of the need for geophysicists and particularly seismologists at the source of district geology. Direction and coordination of district programs could be handled more efficiently through these men. The housing shortage created a growing dissatisfaction with the "nomadic" life among old party chiefs with growing families. A number of new district geophysicists resulted.

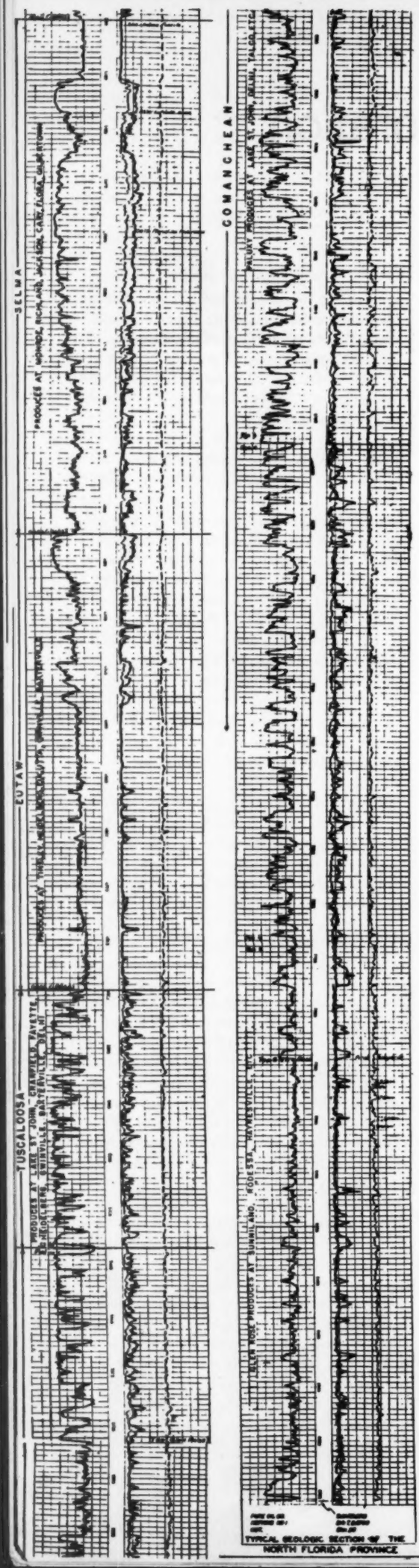
These companies now exhibit confidence in the seismologist's ability to successfully overcome the problems involved through long range experiment and accumulated experience in these areas. The ever present human element in the interpreting of seismic data is now accepted by most production executives as a real factor in the effectiveness of exploration problems which include seismic work. A general thinning in the ranks of top seismic interpreters in major company organizations during the war has concentrated the burden of final interpretation and coordination with geology upon fewer men. The resulting tendency is to give these men higher authority and finally some voice in the exploitation policy as related to seismic prospects.

To maintain the quality of field interperpretative personnel in many major organizations, the "party manager" system has gained favor. Use of this system, although impracticable in remote operations, should result in much closer integration of geology and geophysics as daily interpretation of field seismic records is conducted in district headquarters nearest the field operations.

In the field of geophysical research no radically new methods have appeared. Most geophysicists think that none will appear but the field of improvements in existing methods, instruments and equipment, is considered to be wide open, particularly as related electronic apparatus and transportation equipment. Active geophysical research was curtailed during the war by loss of technical personnel. Many top geophysical researchers are continuing in government work or have been attracted by higher paying jobs.

Many geophysical departments and companies are now beginning a program of rehabilitation of long used equipment and instruments. The growing need for increased resolving powers of seismograph methods in the exploration for low relief structures and particularly for the delineation of stratigraphic features presents a real challenge to the industry's research and development staffs. The added impetus of peace time competition should increase the probability of success in this field.

*Mr. Anderson, for 11 years, was associated with Sun Oil Co. as seismologist at Beaumont, Texas in charge of field operations in the Gulf Coast area. In January 1945 he joined L. E. Randall in The Geophysical Engineering Co.



North Florida Province Is Geologically Attractive

BY DR. JOHN D. TODD*

THE North Florida Province is considered to comprise Florida north of the Central Platform, and the related adjacent parts of Georgia and Alabama. It has long been considered by some geologists to be deserving of serious consideration as potential oil territory and is now receiving the active attention of a number of oil companies.

No attempt is here made to discuss peninsular Florida, except to note that it has surprising structural features and that the exploration of its manifest possibilities is being actively led by the two largest companies in the business.

One condition that perhaps discouraged scientific oil search in this part of Florida was the fact that many early companies were promotional enterprises and the wells put down by these converns were drilled to encourage the sale of stock, with no geology and no records kept. By 1941, although 80 wells had been dug, only four were considered significant in oil circles[1]. Starting in the late thirties, Florida began to receive serious consideration by major companies, who started to buy leases and support wells. And the first test well ever dug by a major company in Florida, though not within the area here under discussion, became an oil well—Humble's No. 1 Gulf Coast Realties at Sunniland!

Interest in Florida, which had been slowly maturing, was hastened by this actual discovery of oil by the Humble Company in the southern most part of the state. By 1945 there were twenty company offices in the area, and 75 listed independents and brokers[2]. Fifteen full time, resident scouts write a weekly letter on this province[3], the AAPG lists 41 members in the area[4], and AIME shows 74 members there[5].

Geophysical activity has yearly increased, to a high of 1397 crew weeks last year[6]. About five-sevenths of the area is under lease, with Humble and Gulf as largest lease holders, followed by Sun, Tidewater, Pure, Texas, Sinclair, and California[3]. The number of test wells shows some increase, and the character of the wildcats has completely changed; most of the wells now are dug by major companies, are deep, carefully cored and fully tested. Information concerning the plans of the interested companies, indicates that between 20 and 30 wildcats will be dug in the area in 1946[7]. The province is on the threshhold of its first real, serious, scientific development. Leases being acquired by nearly every major company and many large independents, and minerals rights being actively bought by the major companies and conservatively managed royalty concerns, indicate a recognition of the potentialities of the area.

Rocks from Recent to Upper Eocene are exposed[8], the Ocala being the oldest formation found on the surface in this area. This Ocala is the great commercial aquefer which feeds hundreds of water wells vital to the region; and because of the availability of the data many maps have been contoured on "Top of the Ocala." All of these exposed rocks are fresh water bearing and are probably too shallow to serve as petroleum reservoirs in this area. These surface beds seem to have no persistent markers so that while little surface work has ever been attempted in this area, it could be difficult and doubtful.

Below the Tertiary, which has been brilliantly described in the literature[9], lies a Cretaceous section composed of the Selma, Eutaw and Tuscaloosa, well known as the producing sections in Mississippi. Electric log from a centrally located deep well, Pure No. 1 Hopkins in Gulf County, serves as Plate I to illustrate the typical subsurface section.

The Selma, as marked on Plate I, has become somewhat sandier and should be a better reservoir than it is at Tinsley where it produces in Mississippi. Reef conditions would not be unexpected, and large porous blankets like the Jackson and Monroe "gas rocks" might be present. Between the sandy bodies, the Selma is a firm tight chalk that forms a perfect seal over the oil in any formation below it, and would explain the paucity of seepages.

Beneath this marine Selma lies the marine Eutaw, composed of sands and shales, as shown on Plate I. It blankets the entire province and almost everywhere carries sizeable sand bodies. This same formation is already producing in many fields including Tinsley, Eucatta, Gwinville and Baxterville and its equivalent produces in north Louisiana and in Texas; so there is no reason to doubt that the Eutaw will produce in Florida when found on structure. Gas shows in the Eutaw have been reported in wells in Washington, Jefferson, and Levy Counties (See wells Nos. 3, 11, 17—Plate II), and the Eutaw is a definite producing possibility on all structural traps.

The Tuscaloosa lies just below the Eutaw; in northern Florida it is thought to be of shallow

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← Plate 1—Electric Log of Pure Oil Co. No. 1 Hopkins, Gulf County, Florida, from Top of Cretaceous.

water origin but in southern Georgia it is definitely marine[10]. The Tuscaloosa section, marked on Plate I, is the most potential producing horizon in the North Florida province. It is the equivalent of the prolific Woodbine of East Texas, and is the basal sand member of the Cretaceous section which has yielded so much oil all over the world. In this province the Tuscaloosa is an ideal reservoir, being composed of coarse sands and chicken-feed gravels; in fact, Prof. Munyan in his classic article[11] mentions the "coarse sand" and "gravel" character of Tuscaloosa cores more than 27 different times. In most parts of the province here under consideration the Tuscaloosa can be reached between 3000′ and 4000′ which is the very same level where it has proven itself in Northeastern Louisiana. A show of oil in the Tuscaloosa was reported in the St. Mary River Oil Corp. No. 1 Hilliard (Well No. 15 Plate II) in Nassau County, Florida.

Enough wells have drilled through the Cretaceous and into the Comanchean to indicate that it is a section of sands and shales that looks most interesting. This same formation is a prolific producer in East Texas and North Louisiana, and the producing Sunniland Lime in southern Florida is of Comanchean (Glen Rose) age. Some wells have drilled through the Comanchean and into the underlying Jurassic, Triassic and Paleozoics. While information is meager on these lower formations, a black shale with oil odor was encountered in the Paleozoic section of the Nassau County well[12] (well No. 15—Plate II). These older rocks have produced gas at nearby Amory and Fayette, and have yielded hundreds of millions of barrels of oil in other states.

A well dug to the basement in the panhandle of Florida would test every formation that produces in Alabama, Mississippi, North Louisiana, Arkansas and East Texas. Along the coastline the basement is probably too deep to be reached by drill.

It was for years assumed that the subsurface of this area was plain and flat, but this now seems far from true. A number of known and inferred large structures make the area very interesting and offer many possibilities; and gravity and magnetics suggest many other features and regional faulting. The locations of the more generally recognized features are shown on Plate II; and the contours indicate the grain of the country on top of the Cretaceous. A brief outline of the known data on each is here set forth:

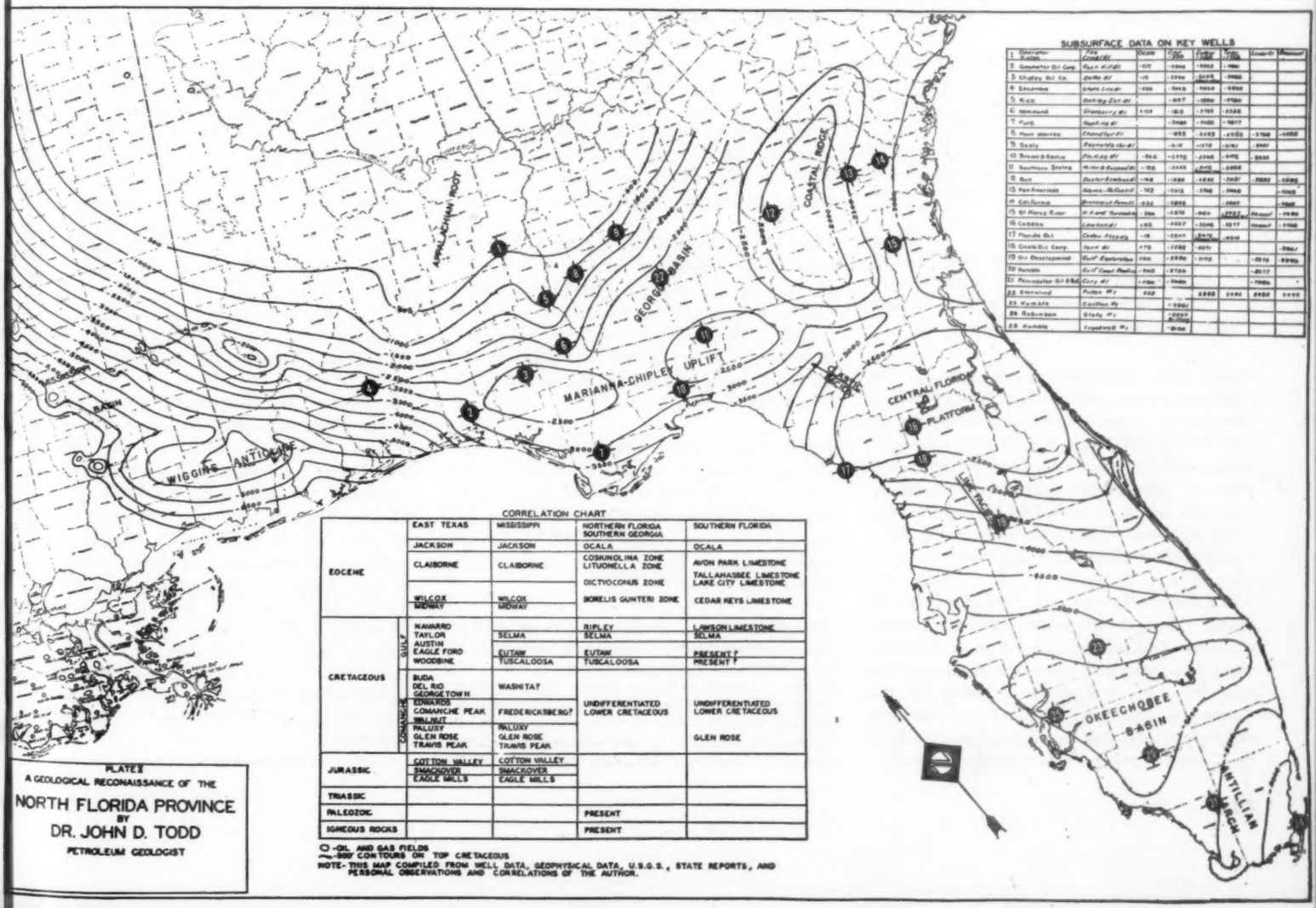
• • •

FINDS SATURATED DOLOMITE

Benedum-Trees State No. 1 wildcat in Dale County, Florida, which is shown as No. 24 at the southern tip of Florida in the map below, has encountered saturated dolomite and lime at 10,160 feet and below. As this was written (February 21) 72 feet of section had been cored. Most of this was found to be saturated. Mr. Mike Bendum was quoted as saying "we have found a first class oil field."

The Coastal Ridge seems to parallel the Georgia coastline and to be a very old feature. Wells dug on this ridge encounter granite at above 4500′; for many years this looked like an area of thin sediments with the counties to the west even thinner. However, wells dug further west have now made it clear that this Coastal Ridge is not a part of the Appalachian Uplift, but is a distinct feature separated by an intervening basin. Wells on the ridge go from a thin Tuscaloosa section into granite; wells further west have a thick Tuscaloosa section[10], Comanchean, Jurassic, Triassic and Paleozoic sections. Authorities believe that this ridge is a part of the Old Appalachia landmass[13], and that it may extend far down into Florida[14]. The presence and importance of this ridge has been noted by Garland Peyton, director of geology for the state of Georgia[15]. A nearby granitic mass like this explains the source of the coarse sand and gravels found in the Tuscaloosa. Prospecting on this ridge will have the advantage that less structure may be needed, but it has the disadvantage of a thin sedimentary section with fewer objectives.

The Georgia Basin consists of the trough between the Coastal Ridge and the Appalachian Root, and very probably is the eastern edge of the Old Appalachian Geosyncline[16]. The extent of this Basin is vaguely outlined by deep wells in Mitchell, Daugherty and Early counties, Georgia and Barbour county



Alabama (Wells Nos. 4, 8, 9, and 22, Plate II). The thick, marine sedimentary section in this area offers a multitude of objectives, and constitutes an ideal place to search for structures. The unusually thick and highly marine character of the Tuscaloosa in this basin was commented on by Dr. Richards in his article[10].

The Marianna Chipley Uplift is a regionally positive area below the Florida-Alabama state line; it is as yet largely undefined but seems to be a continuation of the well known Wiggins Anticline from Mississippi. The Marianna Chipley Uplift was mentioned in the early literature[17] and repeated by the Applins in their catalog of known structures[9]. This feature is indicated by the Ocala inlier and shows up on a Eutaw Isopach. Sand conditions are known to be good in this area and the sedimentary column should be ample; so along and around this feature will be excellent prospecting ground.

The Central Florida Platform is the name given to the great positive area that seems to divide Florida into two unrelated geological provinces. Insufficient wells have been dug to outline the subsurface extent of the Ocala Uplift, but it appears to be only the western part of the larger platform, which we know of through magnetics, gravity and isopachs. North of the Platform the sediments are mainly clastics, the strike is NE-SW parallel to the Appalachian folding, and the entire area appears to be geologically a part of the southern United States. South of the Platform the sediments are almost entirely limes, the strike is NW-SE (almost at right angles to north Florida) and fauna suggest a close relationship to Cuba and Mexico[18]. This platform appears to be larger than the Sabine Uplift, with plenty of room for Caddos, Bull Bayous and Homers on top and East Texas's and Rodessas on the sides, but one well to the metamorphics indicates the sediments may not be too thick in places.

Southern Florida, though not under consideration here, seems to be dominated by the Okeechobee Syncline and the Antillean Arch. While the presence of these features is confirmed by widely scattered well data and seismic work, their exact extent and importance is not yet known. Some uplifting in this country might be inferred from the fact that the highest elevation in all Florida is near Lake Wales, some 60 miles east of Tampa.

So few wells have been dug that in large areas we can not be sure where dip and strike is, particularly on the deeper beds beneath the two angular unconformities.

Sediments of the Lower Cretaceous and the Paleozoics are not exposed along the southeastern front of the Appalachians and they do not go over the Coastal Ridge, but they are present in wells in the Georgia Basin. So they must pinch-out both eastward and north-westward, or are truncated which is preferable to updip depositional pinchout. Along both flanks of the Basin stratigraphic traps are a real likelihood.

The Eutaw sands are not believed to go over the Central Platform and must pinch out along its northwest flank; these sands are good reservoirs, closely associated with marine formations, so that possibilities of stratigraphic trapping in the Eutaw are considered good. The Tuscaloosa definitely pinches out on the northwest flank of the Central Platform, a fact which the Applins take note of in their cross section[9], and the depth and character of this pinchout is so identical to the East Texas oil field as to be startling! The East Texas pinchout was noted in the literature as early as 1926[19], but remained largely unleased until oil was actually discovered; likewise the possibilities of an oil field bigger and better than East Texas are just beginning to be noticed in North Florida and will be actively drilled for by at least two companies in 1946.

The presence of large regional features raises the presumption that these same structure-forming forces produced many other and smaller traps of the kind that usually yield oil. The structure at Sunniland, in the southern part of the state, appears to be a large anticlinal fold. Although only four wells, at one mile intervals, have been dug a definite north-south turnover has been established. There appears to be in excess of 50 and possibly 100 feet of closure on the producing lime, that may cover several thousand acres.

Of the structures that can be anticipated in the North Florida Province anticlinal folds will probably be the most prevalent. The size, shape and build-up of the gravity maximas in this area, indicate that these structures can be expected to be larger than most salt-core folds and more like the Mid-Continent oil fields. Salt domes are not to be expected, but if present would be along the coastline of western Florida.

A great many faults are almost sure to exist and there will be closures against these faults in places. No doubt some of the gravity maximas we have are reflecting structures of this kind, and zones of rapid gravity change are being leased in anticipation of faulting. Later basement movements would warp the overlying sediments and produce many closed traps. The presence of this type of trap would show up in both the gravity and the magnetic patterns.

There has been insufficient drilling to prove or disprove the presence of these local structures, but geophysics point to their existence and they have been found in every similar province where enough drilling has been done. Experience has shown that it is not the absence of structure, but our inability to locate and interpret it that keeps the oil discovery rate down.

The Sunniland oil field was found by the Humble reinterpreting the Gulf's gravity data, and then checking the area with 1000′ core drilling. Some experimental reflection work was attempted in the area. Inquiry as to the effectiveness of geophysics in the area develops the following information:

The Seismograph, ace oil finding tool of the industry, has encountered almost overwhelming difficulties in this Province. The cavernous surface, ground roll, absence of deeper reflecting density changes, acute lateral velocity variations, and lack of experience in the area have combined to hold reliable reflection seismograph results to a bare minimum. However, after several months of difficulties, by using a shallow reflection, the Petty Company was able to do successful mapping in the southern part of the state[20]. And by refractions the position of the basement can be located, and the top of the Selma can often be mapped.

Magnetics are proving most helpful, and some companies are supplementing their gravity data by taking magnetic readings on the same stations. Magnetics will give a definite idea of the position and shape of the basement, and because it is cheap, is considered more desireable for this than refractions.

Gravity surveys are fast, cheap and well understood, because of their broad use. Gravity is being effectively used by all the companies for mapping the huge areas that must be covered in this province. Based on many years experience in this and similar areas, a gravity map will enable you to pick out the one-fourth of the acreage which will yield 90 percent of all of the oil fields to be discovered in the area[21]. The recent phenomenal success of gravity in Mississippi gives this method a position of pre-eminent respect in this new province.

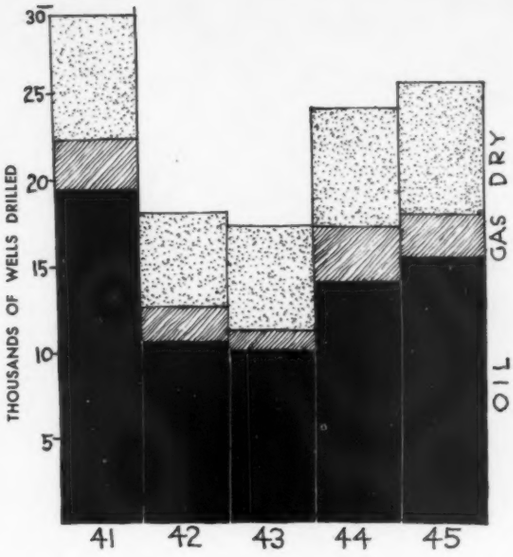
Core drilling, while not a geophysical method, was helpful at Sunniland and will no doubt prove of further value in solving problems covering a limited area. The method is very expensive and equally slow, and although used persistently by Humble and Pure it has covered very little of the area.

The land situation is reasonably diverse, so that tracts of all sizes are encountered in most areas of interest. Large parts of the province are cut-over woodlands and the growth is used chiefly as a source of pulpwood and naval stores; a fair fraction of these lands are owned by nationally known corporations.

Leases were "free for a well" for years, and in the late thirties the Sun established a price of five cents an acre for commercial leases. The coming of the Humble and California pushed the price up to 10 cents; such early leasing was non-selective and designed to tie up the largest tracts for the longest time at the lowest price. Diminishing acres, more buyers, and geophysics to guide buying, carried the prices through 25 to 50 cents and on up to $1.00 an acre in any area of interest. Lease buys at $5.00 and $7.00 an acre have been reported in several areas and $10.00 an acre has been paid for desired small tracts by the Shell. Such leasing as has been selective and for which higher prices have been paid has usually been based on gravity surveys.

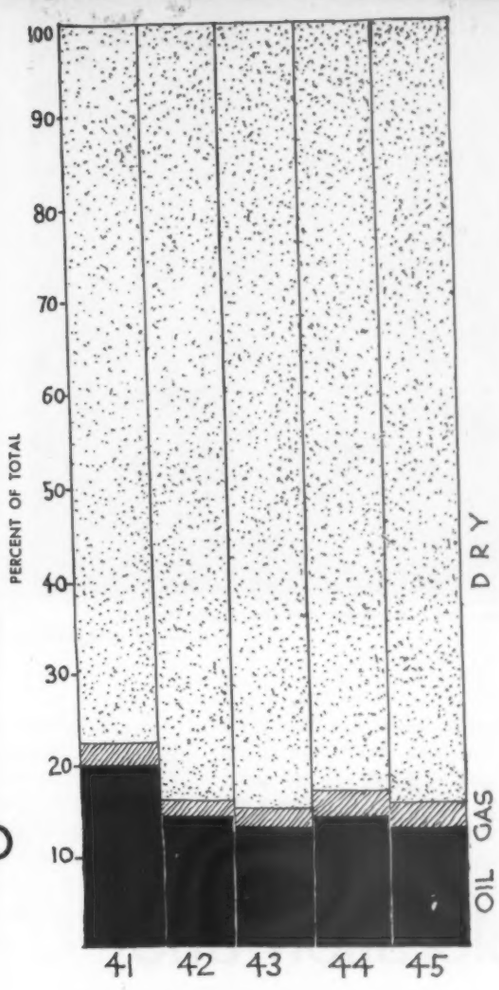
Minerals similarly went begging when the area was considered non-petroliferous, one trade having been reported at two and one-half cents a mineral acre. Some sizeable amounts of minerals were bought for something less than $1.00 base and very large amounts were bought at $1.00 base, most of this early mineral buying being "under any company lease anywhere." Minerals are now being actively bought on the better known gravity prospects at $4.00 to $8.00 base and up to $20.00 base has been paid around well considered wildcats. The prices in the North Florida Province have followed exactly the pattern developed in Mississippi; and are now at the pre-development level reached in Mississippi about 1938.

(*Continued on page* 94)



Of the 24,540 Wells Drilled in the U. S. in 1945 for Oil, 7,463 Were Dry, 2,794 Gassers and 14,283 Produced Oil.

NEW PRODUCTION RECORD IN 1945



Eighty-Four Percent of the Wildcat Wells Drilled in 1945 Were Dry, Three Percent Produced Gas and 13 Percent Oil.

A NEW record in domestic production and a near record in fottage drilled was established by the industry in 1945 in spite of the removal of war pressure in the last five months of the year. Had V-J Day been delayed until December 31 the industry no doubt would have drilled more footage than ever before.

Domestic crude production rose 2 percent in 1945 to 1.74 billion barrels. Had the August peak rate of nearly 5 million barrels per day been maintained through December the year's production figure would have risen 6 percent over 1944 to 1.77 billion barrels. The industry was operating under an overloaded condition toward the close of the war and welcomed the opportunity to cut back, but it cannot be doubted that the August rate would have been maintained or exceeded had the nation needed the oil. In two wars within the business life of thousands of oil men the industry has been called on by the government for extraordinary achivements and in both instances every demand was generously met. At the beginning of 1945 the PAW set a goal of 27,000 new wells for the year. Counting 2,217 input and other service wells the industry approximated the government request even though pressure was removed five months before the year end and in spite of many difficulties in obtaining equipment and manpower. Excluding service wells the domestic industry completed 24.540 wells to an average depth of 3500 feet. Of the wells drilled 58 percent were producers, 12 percent gas wells and 30 percent dry.

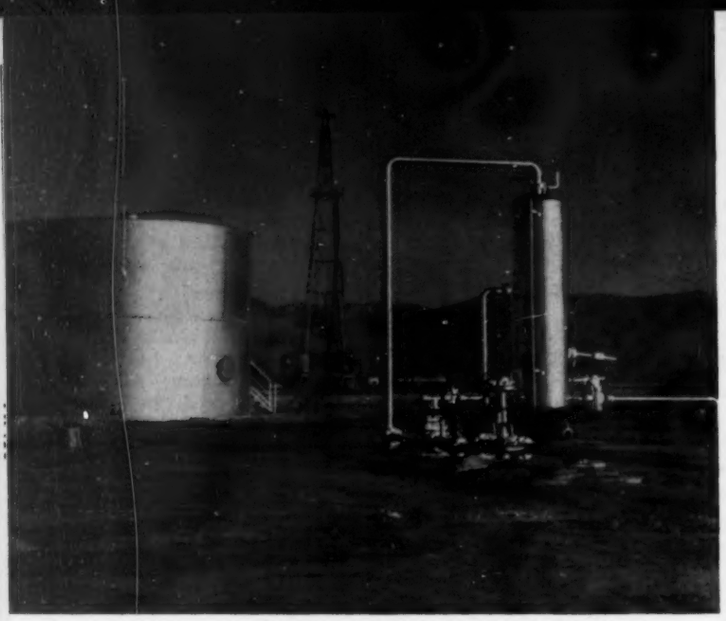
The industry was asked to drill 5,000 wildcats in search of new oil and responded with 4190 completions. The discovery rate on wildcats was somewhat less satisfactory than in recent years. In 1945 84 percent of wildcats were dusters, 13 percent produced oil and 3 percent produced gas. In 1944 14.7 percent of wildcats were oil producers and in 1943 the percentage was 13.7.

Even in development wells in proven fields failures were substantial in 1945. Out of the 20,350 development wells, service wells being dry and 13,785 or 67.7 percent were oilers. Gas wells totaled 2610 or 12.6 percent.

Average depth of all wells continued to increase in 1945. East of the Mississippi depths have not changed materially but in the South and West the drill is biting deeper and deeper into the earth. In Louisiana the average depth of all wells was around 7,000 feet in 1945. In the Gulf coast region the average was 2,000 feet and toward the end of the year most of the wells were headed for 12,000-foot depths. Texas Gulf Coast and Mississippi wells also averaged near 7000 feet, well above the general inland areas in the mid-continent. There seems to be no doubt that the deeper drilling trend will continue through 1946.

The size of new oil discoveries in 1945 was not impressive. Wildcat strikes failed by a wide margin to keep reserves from depletion during the year. It was only through reappraisal of reserves in older fields in the light of improvements in producing techniques and through extensions that reserves were estimated at a larger figure at the end of the year. After producing 1.74 billion barrels the industry still had proven reserves of 20.8 billion barrels, an increase of 0.5 billion barrels during the year. Extensions to and revisions of reserves totaled 1.7 billion barrels and a new discoveries 0.4 billion barrels.

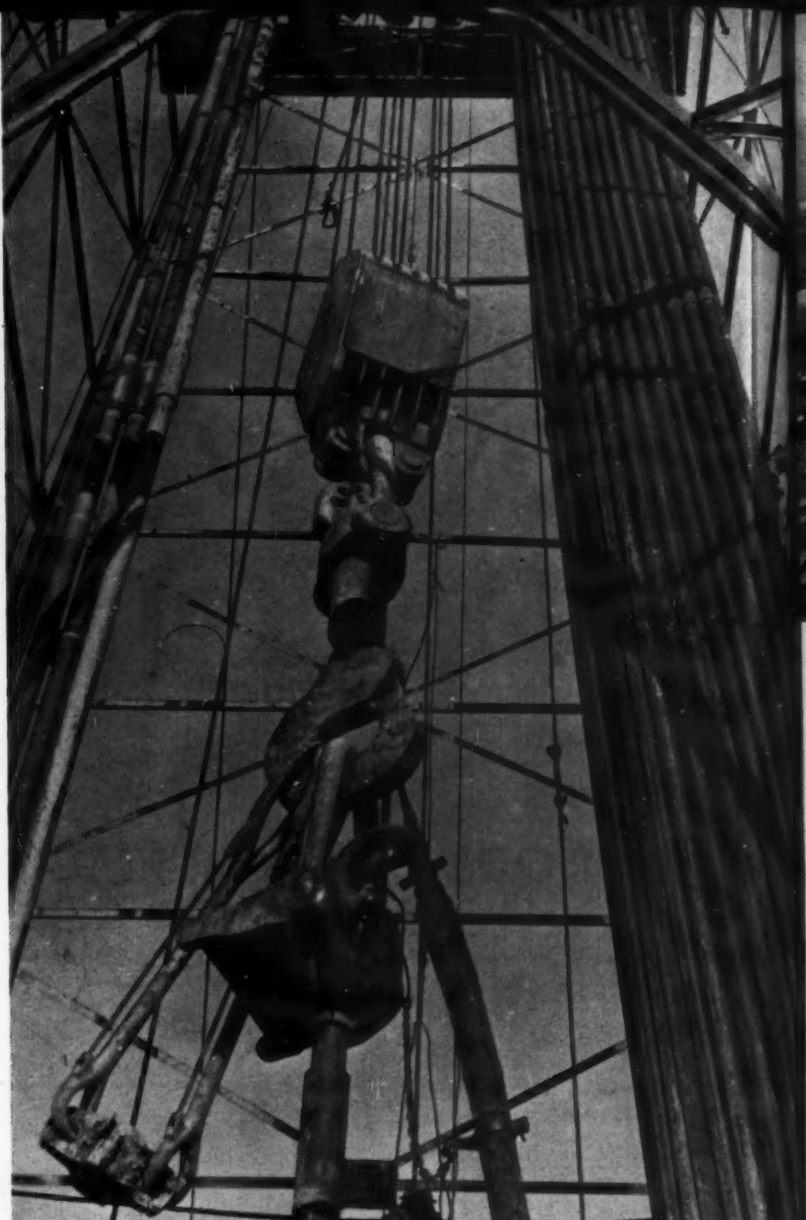
As discussed in detail elsewhere in this issue California had a disappointing year in discoveries with more than half of the nation's reserves, Texas only a minor increase in reserves, Kansas and Oklahoma lost ground during the year in spite of a most active drilling campaign in Oklahoma. Considering the size of previous reserves Colorado with its roaring development of the Rangley field and Mississippi were outstanding in their increases in reserves.



British American Oil Company Well in the Grape Vine Area Which Extended the Field a Half Mile.

California Exploration and Production Trends

BY NICHOLAS A. D'ARCY, JR.



Eight Thousand Feet of Tubing is Racked in Richfield Oil Corp. Union Pacific No. 1 in the Bandina Area While Drilling Ahead After Successful Production Test.

EXCEPT for wildcat drilling and exploratory work which went on without interruption throughout the year, California production practices for 1945 can almost be divided into pre and post-VJ day activity. Shallow drilling decreased substantially immediately after VJ-Day. The largest single factor in the change of California production was the shutting in of Elk Hills with a cut in production of 50,000 barrels daily in this one field alone immediately after VJ-Day. This was sufficient to balance California supply and demand.

Exploration continued in all sections of the State, and like 1944, the large amount of exploratory work received little reward. Substantial new fields were not discovered, new pools were few and held little promise of important production. New zones discovered at a depth of 2300 feet at Edison and depths of 3600 feet and 4700 feet in the Cymric area gave the industry the greatest encouragement.

Discoveries are largely credited to geological methods rather than geophysical surveys. Much of the geological data is collected from subsurface records and surface geology played but a small part in either discoveries or the choice of wildcat locations.

Nature of Discoveries

One of the most interesting 1945 discoveries, both from the standpoint of new geological information and potential production, was the fractured schist zone at Edison, near Bakersfield. The Lower Duff zone was discovered at Edison in 1934. Subsequent drilling established as the field's basement the Jurassic fractured schist underlying the Lower Duff. In June Harry H. Magee, operator, drilled 30 feet into this basement fractured schist and brought in a producer with an initial of 300 barrels per day. Approximately 35 other Edison wells now are producing from this zone. This discovery has caused operators in other fields to examine their basement rocks when they consist of fractured schist and some of the Long Beach wells give promise of producing.

The Cymrica area of Kern County is the location of three more discoveries which may connect

View From Crow's Nest of Marine Exploration Company's Directionally Drilled Well Terminating Under the Ocean at Seal Beach.

the Cymric and Sheep Springs fields. Union Oil Co. brought in the discovery well of the new Anderson 45 zone in August at 3610 feet for an initial of 1094 barrels. The Independent Exploration Co., a new-comer in the drilling and exploration field discovered the Brunt zone, of the Cymric area at 4700 feet for a 956-barrel initial. The Independent Exploration Co.'s Oceanic No. 1 made the discovery of the Brunt zone about midway between the Union Oil Co's. Anderson No. 45 and the Sheep Springs field. The last discovery credited to 1945 by the California Conservation Committee was another Independent Exploration Co. well closer to the Sheep Springs field. There are several wells producing from the new Cymric zones and it looks like a new proven producing area.

One of the most heartening discoveries of the year was the Santiago pool brought in by the Western Gulf Oil Co's. Woodward No. 2 in the Midway-Maricopa district. This well is near the old producing fields south and east of Maricopa. Western Gulf penetrated over 800 feet of oil sands in completing Woodward No. 2 at a depth of 2678 feet and obtain an initial of 1236 barrels. The productive index of this well was over five and the pressure drop was so slight that the only way the productive index could be calculated was to use the relation between shut-in pressure and initial flowing pressure. Subsequent wells reached the 2000-barrel mark and penetrated over 1000 feet of productive index of 15, which was unheard of previously in California, and the next well jumped to an index of 33. The sad part of this discovery is that the producing formation seems to be a very steeply tilted lenticular body.

Both Western Gulf and The Texas Co. completed a fine producing well followed by a duster in the Santiago field. Indications are that the field will be very limited in extent but the wells on formation will be remarkable producers.

The deepest discovery in the state was made by the Barnsdall Oil Co. on the Rancho San Fernando in the Newhall-Potrero field. The 6th zone was discovered at a depth of 11,229 feet with an initial of 530 barrels. Barnsdall has deepened an older well which also resulted in a satisfactory producer from the 6th zone

The shallowest producer classed as a discovery well for 1945 was Layman No. 1 drilled by the Williams Brothers Oil Co. in Kern County. This well discovered the McDonald Anticline with an initial of 35 barrels from a depth of 853 feet.

An accompaning table shows all discoveries in California in 1945. Six of the 22 accredited discoveries were in the Casitac area which includes Oak Canyon, Del Valle, and Newhall-Potrero.

Wildcat Drilling

The spectacular wildcat drilling jobs of 1945 in California all resulted in dusters. New Year's greetings to the oil industry was the completion of Standard of California's record breaking KCL 20-13 at a depth of 16,246 feet. A duster! This seemed to set the pattern for deep wildcat wells for the entire year. Almost every major field had its deep test with disappointing results.

Standard of California also drilled 11,080 feet in the old Lost Hills field and did a wonderful job of penetrating one of the most difficult formations in California without major trouble. Splendid mud control and close supervision enabled Standard to conquer the high pressure, hot salt water zones and the treacherous formations where lost circulation was a constant problem, but no oil producing zone was found.

Richfield Oil Co. contracted with Rocky Mountain Drilling Co. for a 14,000-foot well in the San Emidio ranch area but no oil production was obtained. This well was interesting in that 12-¼-inch hole was drilled to a depth of 12,193 feet. Total depth was 12,674 feet. The search has not stopped in the San Emidio area. K. L. Kellogg and Sons are contracting two wells of Western Gulf Oil Co. in this area higher up the alluvial slope than Standard's wildcat. Other major companies have large holdings in this area and additional activity is expected there in 1946.

The Fillmore area was the site of another Standard deep test. The Camay Drilling Co. penetrated to 13,321 feet in a wildcat for Standard in that area. This well was drilled with diesel powered rig and it is the deepest drilled with that type of equipment in California in 1945. Three 200-horsepower diesel engines were used. It was in this same area that Loffland Brothers drilled beyond 14,000 feet with internal combustion engine power in 1944 to complete the deepest wildcat in Southern California.

Chanslor Canfield Midway Oil Co. is drilling the deepest well in the Ventura coastal area. This well is drilling beyond 14,000 feet and is one of the deepest ever drilled in California with electric power.

Two other interesting deep wells were begun in 1945. They are Shell Oil Co. Inc., Alamitos 48-A at Signal Hill and Richfield Oil Corp's. Union Pacific No. 1 in the Bandini area. Shell has drilled 14,950 feet at Signal Hill and is still testing. Richfield has made successful production tests on the Bandini well and has three more wells drilling in that area. This well will probably be one of the first official discoveries for 1946.

General Petroleum is still testing deep structures in the Buena Park area, where it brought in a discovery well in 1944, but no other successful producers were recorded in 1945. Loffland and Brothers are contracting the Buena Park well and

are drilling with steam equipment.

There are two other areas which demand mention. The Imperial Valley district near Salton Sea was a hot spot for drilling late in 1944 but 1945 drilling failed to penetrate any formations of sufficient interest to warrant further exploration and now the area is idle. The Texas Company was active during much of 1945 in Oregon but has run into very difficult drilling. The area being tested has a sheet of basalt underlying the surface alluvial gravel and this volcanic mass is both hard and very porous. One well had to be abandoned due to inability to stop loss of circulation in the basalt caverns and the second well required 45 days to penetrate the first 1100 feet. No report on prospects in the Oregon wildcats is available.

Elk Hills continues to hold the interest of those concerned with exploratory work. Under new appropriations granted by Congress, development work is now being carried on to prove the extent and potential production of the deeper Elk Hill zones. While this will not add to the available commercial production of California it will yield interesting geological data.

Exploratory Methods

Of the 22 discovery wells in California only one gives geophysical methods credit for the discovery. The other 21 are credited to geological methods. How important a part geophysical methods had in assisting field geology in the location of likely locations is not known. In the recent past geophysical methods of discovery were most successful. Several of the important California fields were discovered from information developed with seismograph surveys. Seismograph parties are still in the field but new California possibilities seem to consist of small structures. These include fault traps, lenticular strata, shore line accumulations and other structures hard to identify positively by geophysical methods alone.

Present trends are to supplement the seismograph surveys with deep core holes to obtain geological sections of the area being surveyed. These deep core hole records are being obtained on a regular co-ordinate pattern. When a production test is desired the small core holes are reamed out to 6-⅝ inches. Interesting new equipment has been developed for this work. Light truck mounted core drilling rigs with separate engines to power the slush pumps are now used to drill to 2500 feet. The cost of this work is moderate and some progressive operators are planning core rigs capable of drilling to 10,000 feet at an estimated cost of from $2 to $4 per foot. This type of equipment will give a positive record of structures at a small fraction of the expense of deep wildcat drilling with conventional rigs.

Most of the wildcat and exploratory wells drilled to below 10,000 feet were drilled with conventional steam rigs. Two interesting developments were the use of 178-foot derricks and the careful attention given to mud treatment. A study of round-trip time with the tall derricks indicates that approximately one hour per round trip can be saved when drilling below 10,000 feet. This is especially true when 4-½ inch drill pipe is used as it racks well in 120-inch stands.

Mud control extends beyond the mud engineers' specifications for mud treatment. This phase is important but the co-operation given the mud engineers by the drilling crew is also necessery for successful mud treatment. On deeper wells it is common to use some method of cooling and degassing the mud in addition to adding chemicals. Fish ladder baffles are used by several drilling organizations. This unit is a wooden or steel tower over which the mud is pumped after circulating in the hole. As the mud cascades down over the riffles the lumps are broken up, gas is liberated and the mud is cooled by evaporation of the water. In Imperial Valley, The Texas Co. ran into such extreme sub-surface conditions that special mud cooling equipment had to be installed. A conventional spray type cooler was used and the mud pumped through the nozzles. This unit worked so well that the mud temperature was reduced from 190°F when it came out of the hole to 120°F. Shell has also used special mud coolers. In these the mud is circulated through coils over which air is circulated by large fans.

There has been a tendency to use a large diameter drill and drill a large diameter hole in many of the exploratory wells. This practice is followed for two purposes both of equal importance. The large diameter hole insures good bit life and also provides room to set an unexpected string of casing if the need arises. Mud circulating pressures are also reduced by the use of 4½ inch drill pipe when it is practical.

Power drilling equipment was used in many of the exploratory wells down to 10,000 feet and on many wells in proven fields of that depth. The outstanding development in this type of equipment has been the widespread use of air clutch and throttle controls. Larger engines are used wherever possible and several rigs now have a total of 1200 horsepower available. Independent power for the slush pumps is becoming the accepted thing for economical power drilling. Some operators are now using two 300-horsepower engines to power their independent slush pumps.

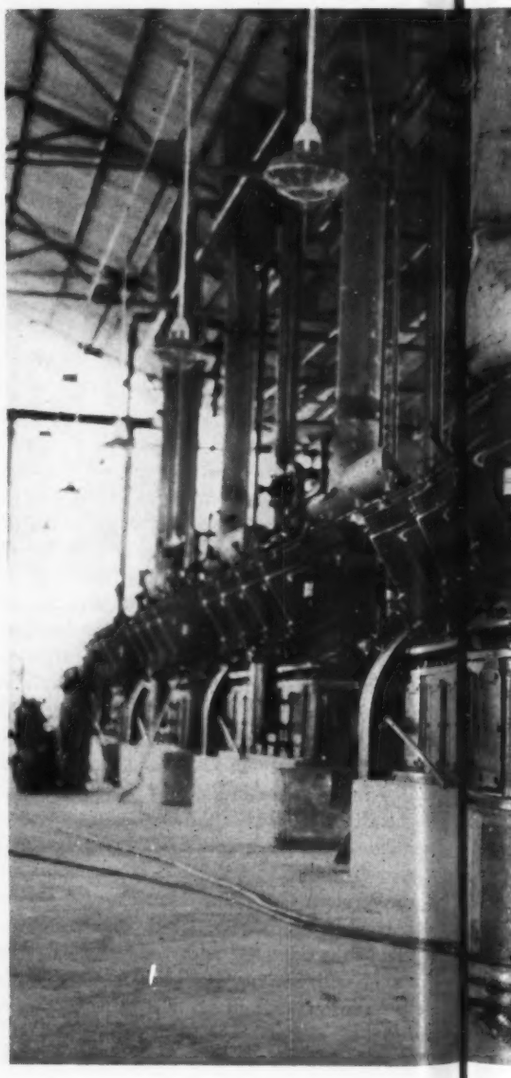
Tide Lands

Development of the tideland oil pools continues despite the political action being taken in Washington. The pending suit against the State of California in the U. S. Supreme Court has slowed down development of the submerged coast line but has not stopped either drilling in the proven areas or exploratory work. Drilling at Huntington Beach, Long Beach Harbor, Rincon and Elwood has continued with little interruption, by directional drilling from "on-shore" locations with the exception of a group of wells directly drilled from existing piers at Rincon and one well from an existing pier at Elwood.

Thomas Pike and Associates is now drilling an interesting directional well at Seal Beach for the Marine Exploration Co. The drilling site is several thousand feet from the shore line and the termination of the well will be beyond the breaker line. It is reported that an angle of 75 degrees with the vertical has been reached. Other directional tideland wells have been drilled with a vertical deviation in excess of 60 degrees with the vertical.

All California oil men are watching with keen interest the progress of the tidelands suit in the Supreme Court. Many feel that Senator Pat McCarran will bring the Senate's quit-claim legislation out of committee to the Senate floor, long before the Supreme Court takes action. The bill has already passed the House and it is felt that California will retain her claim to

New Compressors Installed for Gas Repressuring in the Shallow Producing Zones at Elk Hills.

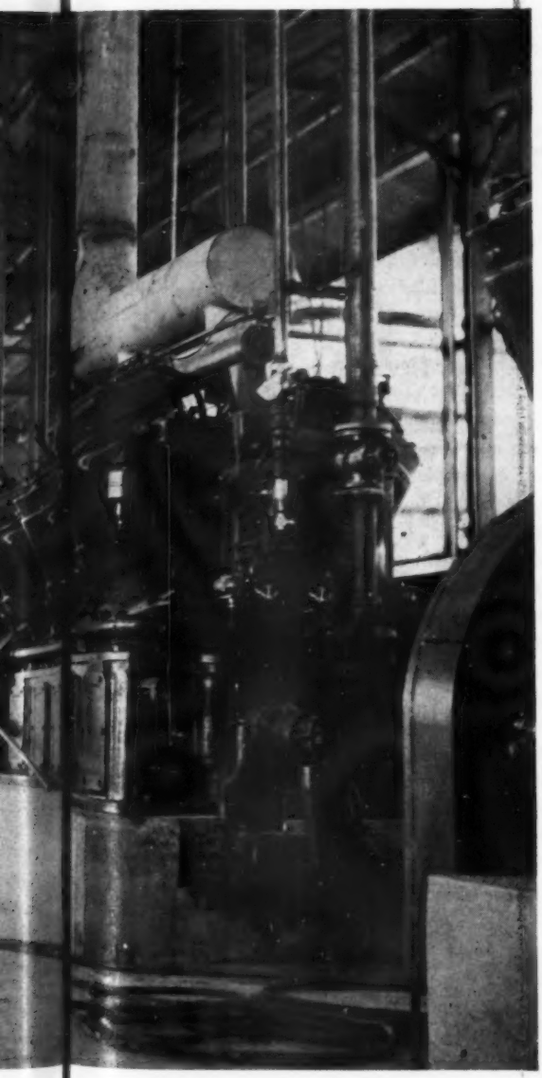


the tidelands. California's claims date back to her admission into the Union when she signed the constitution. Both the Constitution of the United States and the Constitution of the State of California define the State's boundary as extending three English miles into the Pacific Ocean.

Secondary Recovery

Secondary recovery is now starting right along with primary recovery in many new California fields and engineers are working on methods for increasing production from old fields. Recycling and re-pressuring operations are being conducted in several of the new high pressure deep fields still in flush production. No longer are the operators waiting until the field is dead to consider means of increasing ultimate production. Paloma, Ten Sections, Coles Levee, Kettleman Hills, Elk Hills and Newhall-Portrero are a few of the fields equipped with and operating either recycling or repressuring plants.

Water drive and gravity drive are also being tried in some of the older fields but not as widely as gas recovery systems. Union Oil Co. is operating a water drive in the old Richfield area and the Navy and Standard are employing both water drive and gravity drive in certain fault blocks at Elk Hills. Production was increased in one well with special slant hole drilling equipment. Other operators are discussing horizontal drilling from shafts in the old shallow fields but this has not progressed beyond the talking stage.



Unit Operation

Several important fields are now being operated on the unit plan. Elk Hills is the unit most discussed in recent years and it has a splendid record. Other fields in California can point to the advantages of unit operation over many years of successful and efficient operation. Kettleman Hills has been developed under two units, Standard Oil Co. of California and North Dome Association, working in close harmony. Standard has developed its own large holdings while each alternate section, has been developed by the Kettleman North Dome Association. This has been one of the outstanding orderly developments.

One of the more recent unit operations is at Paloma where the Western Gulf Oil is opertor. It has been estimated that the unit operation at Paloma will save $40,000,000 in expense and by increased ultimate production. With savings of this nature made through unit operation the major owners can well afford to give in a little to keep the smaller owners from proceeding with development on an offset-drainage basis.

Gas and Gas Storage

Development of the gas fields has continued especially in the northern part of the state. Industrial plants in the San Francisco Bay area are now benefiting from these discoveries and increased outlets will be enjoyed now that steel is available for pipe lines.

In Southern California an underground gas storage system was developed when gas companies found that they could not meet seasonal home heating peaks in demand without causing hardship to the oil companies. Oil Companies sometimes were forced to burn crude in field boilers to supply gas to the utilities. Many industrial users were curtailed in order to supply gas for home heating. In summer the oil companies have a surplus. In addition to the seasonal variations there is a daily peak load on cold mornings when thousands of homes turn on the gas for an hour or so.

The Del Rey oil field, less than 20 miles from downtown Los Angles, proved to be an ideal spot for a large natural underground storage. The sands are permeable, making it possible to pump large volumes of gas into the formation, and the structure is closed, sealing the gas in. The oil companies now deliver approximately constant volumes of natural gas to the public utility company summer and winter. The excess summer gas is stored underground at Del Rey and used in winter.

California Conservation Committee

The California Conservation Committee is back on the job now that the PAW has closed its office. This group is a voluntary organization whose function is to conserve natural energy in the pools. Its only concern is to establish the maximum efficient rate at which each California flush pool can be produced. Assisted by engineers of all producing companies the committee assures California of maximum ultimate recovery from every flush pool. At present California production just about balances demand and the fear of the committee is one of shortage not oversupply.

Future

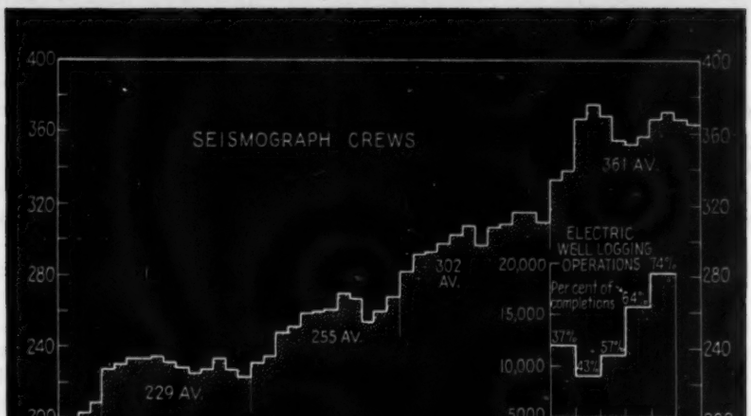
Wih many California cars off the highway many are wondering what the future will be for California. The conservation committee estimates that by early summer demand will exceed the local oil supply. As storage is low oil may have to be shipped into the state. Exploratory work will continue and no doubt more good fields will be found but the fact remains that for the past two years California production has exceeded the potential production from new fields.

Several California companies are developing foreign fields to supplement local production. The Standard Oil Co. of California and The Texas Co., operating as California Texas Oil, Ltd., are developing the Bahrein Island and Saudi Arabia fields and now have formed the American Overseas Oil Co. to develop other property.

Equipment is being assembled for shipment to Sumatra. Standard also is operating several other foreign companies including the active Richmond Exploration Corp. in Colombia. Shell has been doing exploratory work in Alberta, Canada for several years in an effort to supplement west coast production. Richfield Oil Corp. is reported to have established large holdings in the Near East. The Union Oil Co. is preparing equipment for its first drilling job in Paraguay. These activities are an indication of the work already being done to supplement California production.

A pipe line from Teaxs to California is also headline news but no definite operations have been started as yet.

One significant fact is that all companies are proceeding with the construction of new refineries, shipping terminals, storage facilities and service stations. The companies have confidence that California will continue to be a major oil producing state for many years even though they cannot tell where or when the next major pool will be discovered.



GEOPHYSICAL ACTIVITIES IN 1945[1]

BY C. A. HEILAND[2]

THE upward trend in geophysical oil exploration which prevailed during the first three war years continued sharply into the first four months of 1945, then leveled off with a slight drop toward the end of the year, (see Fig. 1). The average total number of geophysical field crews in 1945 was 562, representing a 25 percent increase over the average of 451 in 1944. The average number of seismic reflection and refraction crews was 361 or 64 percent of the total, representing an increase of 20 percent over the average of 1944; gravimeter crews, numbering 172 or 31 percent of the total, were 36.5 percent higher than in 1944; miscellaneous crews (practically all magnetometers), were 29 or 5 percent of the total representing a 26 percent increase over the 1944 average.

The relative proportions of seismic, gravimeter, and magnetometer crews were virtually identical in the past two years, with a slight increase in gravimeter at the expense of seismic operations in 1945. Making allowances for increase in operating costs, the oil industry spent an estimated average of $3,249,000 per month on seismic field work, $774,000 a month on gravimeter surveys, and $72,500 a month for magnetometer and other operations, making the total annual field expense about 49½ million dollars. With an estimated cost of 5.7 million dollars for well logging, the total outlay for geophysical oil work in 1945 is estimated at 55.2 million dollars.

The trend in the statistacal curves after the spring of 1945 invites speculation as to its causes. The effect of the field seasons, evident in the trends of previous years, is again recognizable; superimposed on it, however, is a halting tendency coincident with the achievement of victory in Europe, indicating a disinclination to further expansion and to a layoff of parties toward the end of the year. The curves reflect the industry's uncertainty about post-war demand, labor conditions, and prices, and a tendency to retrench in view of the changed tax situation. Whether this trend will prevail in the future is anybody's guess. A resurgence, or at least a halt in the drop, may result from the fact that reductions in demand were not as great as anticipated, and from improvements in manpower and material. In any event, foreign exploration (not included in Fig 1), should increase as world conditions become more settled.

While well completions in 1945 did not increase greately over those in 1944, the number of wells logged electrically continued its upward trend (see insert in Fig. 1). At this writing the forecast of completions for 1945 is 25,800 of which some 19,000 or 74 percent, will have been electrologged. E. C. Leonardon states that practically all areas in the country, except the Appalachian region, are now serviced by logging units, that side-wall sampling, gun perforation, self-potential dip-meter mesurements, and the use of radioactive marker-bullets (for controlling perforation depths) have steadily increased.

From the viewpoint of the geographical distribution of geophysical oil exploration, the extensive activities in the Eastern Gulf and Seaboard states reported in last year's review, and bringing North Carolina into the geophysical picture for the first time, are again worth noting. A further increase took place in seismic and gravimeter work in the Rocky Mountain States, extending into western Canada (Alberta, Saskatchewan) and as for north as Norman Wells (Imperial Oil Co.) and Cape Simpson, Alaska (U. S. Navy).

Foreign geophysical work - mostly in the Caribbean and South America - increased nearly 50 percent by comparison with 1944, with an average of about sixty seismic, thirty gravimeter, and some geochemical and magnetometer parties reported. The Texas, Creole, Sinclair, Socony-Vacuum, and Atlantic oil companies, among others, continued or enlarged their exploration problems in Venezuela while in Colombia continued high or increased activities were reported by the Shell, Texas, Tropical, Gulf, Socony-Vacuum, and Richmond oil companies. Various parties operated in Cuba, Trinidad, Ecuador, the Dominican Republic, Brazil, Argentina, Paraguay, and Chile, and, on the other side of the world, in Saudi Arabia and Egypt. Russian operations in the "Second Baku"field were highly successful with geophysical discoveries in the Syzran and Saratov areas; as many as 25 electrical and thirty seismic parties have been in this district at one time. Additional structures were found in the St. Marcet field in southern France; and refraction methods were highly successful in the Eakring field, Nottinghamshire, England, where also gravimeter surveys were used late in 1945.

Among noteworthy technical developments were improvements in underwater gravimeter, constrution of an underwater magnetometer and of a submersible tank for gravimeter and operator, and improvements in shallow water gravimeter technique by the use of tripods to 18 ft. depth (Standard Oil Co. of New Jersey), revival of refraction technique (1) with continuous-profiling features and applications in North Carolina, New Mexico, West Texas, Western Oklahoma, Southern Florida, and Ecuador, and (2) in the form of "arc" mapping in England; further uses of the fluorographic and "surface-temperature" (12-75 ft.) methods of exploration; and applications of electrolytic model techniques (S. J. Pirson) to the study of the effects of topography, water table, and permeability-anisotropy upon observed hyrocarbon leakage patterns.

Though probably the least spectacular among the geophysicists' contributions to the war effort, geophysical prospecting for oil and strategic minrals definitely heads the list in this category. It has often been said that wars are fought mainly for the possession of mineral resources. Modern warfare depends primarly on oil and oil products; the largest logistics job in World War II was the delivery of adequate volume of gas and oil, the overseas oil tonnage being nearly twice that of arms, munitions, food, clothing, and medical supplies combined. How the oil companies and geophysical organizations stepped up their operations during the war to supply the increasing demand in the face of shortages of material, transportation equipment, and man power, is indicated in Fig. 1 and needs no further elaboration. Geophysical exploration for strategic minerals likewise increased considerably as the war wore on, largely under the auspices of the Geological Survey and the Bureau of Mines. Such activities as were described in the literature or have been officially released were reported previously in these reviews since 1941. With the increasing tempo of exploration, the manufacture of geophysical instruments likewise increased; however, there was little time for research in the new techniques nor much improvement in the existing ones. Other war projects took precedence, absorbing most of the research personnel of oil companies and geophysical organizations as reported earlier in these pages.

Aerial Magnetic Mapping

Originated by geophysicists in various forms long before the war, this technique was further perfected by physicists and geophysical engineers assigned to the OSRD and Columbia University, to aid the Navy in the location of enemy submarines. According to K. T. Compton's M.I.T. war-record report, the airborne magnetometer, together with ASV radar, was largely responsible for the immediate success in stopping submarine operations near our coasts. Airborne magnetometers were first used some thirty years ago by Edelmann and Carheim-Gyllenskoeld in captive balloons. Next were magnetic measurements in dirigibles (1928 and 1931, during the arctic flight of the "Grafzepplin"). The first experiments with plane-borne magnetometers, involving continuous recording and automatic orientation of the detector unit, date back to about the same time. The Navy's airborne magnetometer is reported to have been tried for the mapping of oil structures in Oklahoma and in Alaska and for the mapping of iron ore in Michigan and the Adirondacks, with reasonably good agreement between air and ground values. Experiments with air-borne magnetometers in certain mining areas of Canada were reported in last year's review. Probabably, some considerable modifications will have to be made in the war-type of airborne magnetic detection equipment to adopt it to geologic reconnaissance mapping; however, a great step forward has been made and will probably result in a wider use of aerial geophysical mapping of water-covered and inaccessible land areas.

The foregoing review does not pretend to be the full story of geophysics' contribution to World War II. Additional information will become available as more releases are obtained and more projects are made public.

Future Possibilities

Geophysical prospecting is said to have received considerable stimulus from World War I developments and detecting devices. This may happen again but unquestionably on a much smaller scale; at this writing at least, it is doubtful if any radically new techniques will be developed. Much publicity is given to the possibilties of radar; according to the best authorities, however, the depth-penetration of microwaves is practically nil, as follows logically from the application of radar to terrain mapping; that is, reflection of the rays from the earth's surface. In order not to be misunderstood, I should add that the electrical characteristics of the immediate surface formations do have, as is well known, an influence upon the propagation of radio waves. Therefore, if is probable that radar patterns will be similar to those reported for broadcast waves some ten years ago by Cloos and others, indicating outcrops of formation contacts, faults, etc. We might, in that connection, remember the claims of our geochemical colleagues, that sometimes deep-seated deposits of oil and metallic minerals are reflected in electrical resistivity variations at the surface.

No doubt, geophysical exploration technique will greatly benefit from many war developments. Generally, such advances will result from war developments in electronics, along the line of tubes, circuits, servo-mechanisms, recording equipment, and the like; and from developments in the field of metallurgy, such as lightweight magnesium and magnetic alloys. Specific applications of war developments will be numerous and will include, in the case of radar, the possibilities of using microwaves in communication, time transmission, topographic mapping, and position fixing. Tubes developed for the proximity fuse may find applications in geophysical field equipment, because of their small size and ruggedness. Seismic exploration will benefiit by war improvements in the composition and application of explosives. By-products of atomic bomb research, such as mass-spectrometers, pumps, and diffusion equipment, may advance laboratory technique in geochemical prospecting and chem-logging; others such as radiation detectors and indicators will assist in radioactivity well-logging, setting of radio-active bullet-markers, in underground fluid-tracing, in mud-logging of permeable formations, in cement-depth logging, and in core testing by induced radio-activity and neutron magnetometer equipment will be used in geophysical surveys of water-covered areas, by ships and planes. Wartime mine detectors will have peacetime uses as treasure finders and pipe locators. Transportation, housing, and sanitation of geophysical crews will be improved greatly as a result of war experience with all sorts of conveyances, improved insecticides, and tropical medicines. Laying of field wire may be stepped up by the use of coil dispensers developed by the Signal Corps for use on pack-board, jeep, or plane. Soon, let us hope, will the gravity surveyor catch up with the meter operator by equipping his car with an automatic odograph; and - by way of a parting shot - if you are employed as an oil-doodle-bugger, please do not worry about your job, because it will be a long, long time before atomic energy can put the oil man out of business.

[1] Abridged from Mining & Metallurgy, February, 1946.

[2] President Heiland Reserach Corporation, Professor of Geophysics Colorado School of Mines; Chairman, Committee on Geophysics, A.I.M.E.

The Fluorographic Method of PETROLEUM X

BY ORTON E. CAMPBELL

THE American Indian read the signs of the trail and bagged the game he hunted. Hunting was the Indian's business. He succeeded at his business, because he learned all the signs significant to the presence of game. The modern hunt for oil is not a chase, but the exploration trail marked by various telltale signs, and the present rate of discovery requires that the modern oil hunter learn and use all the signs significant to the presence of oil.

A notable authority on geophysical exploration has pointed out that a useable method of geophysical prospecting must involve physical measurements of some property of the earth, and that the property measured must have a significant relation to the occurrance of oil. One of the properties now recognized as significant to petroleum exploration is that of fluorescence. The present status of fluorescent prospecting is one of the bright signs along a trail that is becoming rather dim.

The significance of any particular earth property to the problems of petroleum exploration can be established only by surveys conducted and recorded in such a manner that the measurements made, the data obtained, and the interpretations arrived at, can be examined, or reproduced, by other competent investigators. Fluorescent surveys, satisfying these conditions, of the Pierce Junction, Hitchcock, Hardin, Manvil, Mykawa and Pinehurst fields on the Texas Gulf Coast, of the Yturria, and Lockhart fields in south Texas, of the Griffin, Avoca, Strand Hardy, Chalk and Denman fields in west Texas, of the Heidelberg field in Mississippi, and many other surveys have afforded convincing evidence that an accumulation of petroleum is disclosed, and approximotely outlined, at the surface as a fluorescent anomaly.

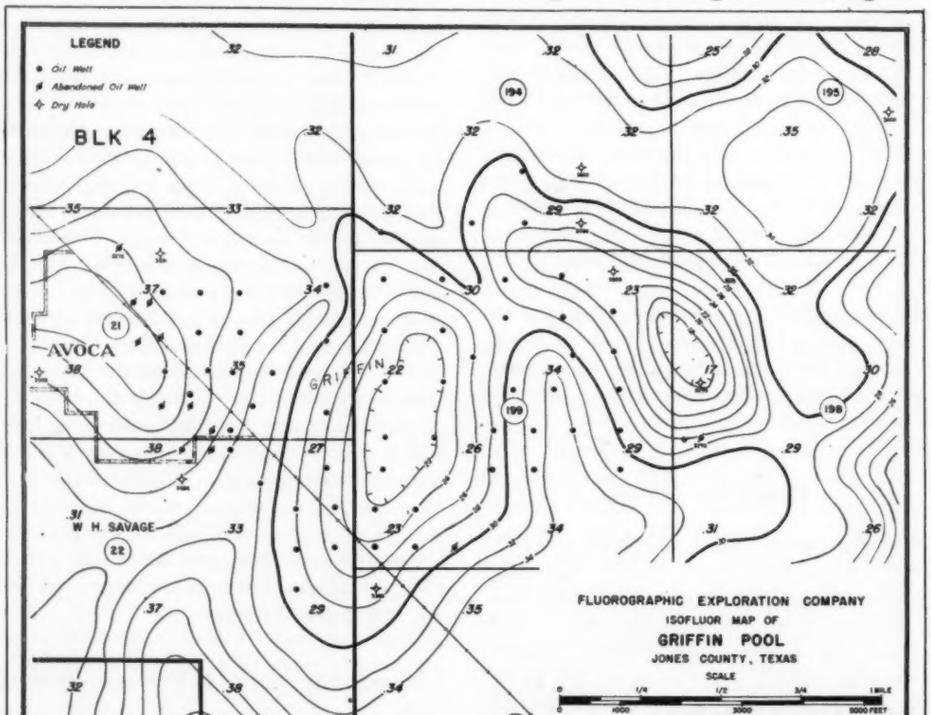
The surveys mentioned were made by the Fluorographic method of fluorescent prospecting, based on U. S. Patent No. 2356454 issued in 1944 to William B. Ferguson, and this discussion is limited to the Fluorographic method. The Ferguson patent pertains to recording, measuring and reproducing measurements of the fluorescent intensities of earth samples or other materials. An instrument known as the Fluorograph has been developed to record fluorescent intensities under standard conditions and to obtain data that is reproducible within a negligible limit of error.

The technique of recording is essentially a matter of exposing a multiple of samples to an ultraviolet light and recording the emitted light on a light-sensitive medium. The densities of the recorded sample images are measured by a transmission photometer. The fluorescent intensities of the samples are readily derived from the photometer readings, since the densities of the images are directly proportional to the fluorescent intensities of the corresponding samples. Many substances heretofore regarded as non-fluorescent record measurable intensities on the Fluorograph, hence it is obvious that this instrument will register the slightest as well as the strongest emissions and affords the widest possible range of measurements.

Both surface and subsurface samples are used in fluorescent prospecting. Surface samples supply data for surface exploration maps, and subsurface samples—cuttings and cores from wells —supply data for fluorescent well logs, or Fluorologs.

Surface reconnaissance surveys are made on a quarter-mile grid pattern. This sample interval affords sufficient data to map all but about ten percent of the prospects surveyed. Detail mapping of complex structural conditions requires that samples be taken at intervals of one-eighth and one-sixteenth mile. An area five miles square (twenty-five square miles) is the extent of an average survey. Samples of one ounce (by volume) are taken with an earth auger at a depth of two feet. Samples may be taken at different times and under different conditions, since their fluorescent intensities do not vary from winter to summer or from dry weather to wet weather. Equally satisfactory results are obtained from samples collected under water in swamplands or from samples collected from dry uplands. No heavy equipment is used, and no areas have been found that were inaccessible to fluorescent prospecting. On average terrain the maximum field cost is thirty dollars per square mile.

Fluorescent data are interpreted chiefly by the conventional method of contouring, since a subsurface accumulation of petroleum is outlined by isofluoric closure. A knowledge of the geological background, information on development work, and previous experience with fluorescent data in the general area, are all helpful in interpreting a survey. Isofluors may be drawn on the intensity values of individual stations, or they may be drawn on control points obtained by averaging station values in multiples of four, nine, twenty-five, etc. The map prepared for the purpose of recommendations depends upon



Map 1. Fluorescent map of the Griffin Pool, Jones County Texas.

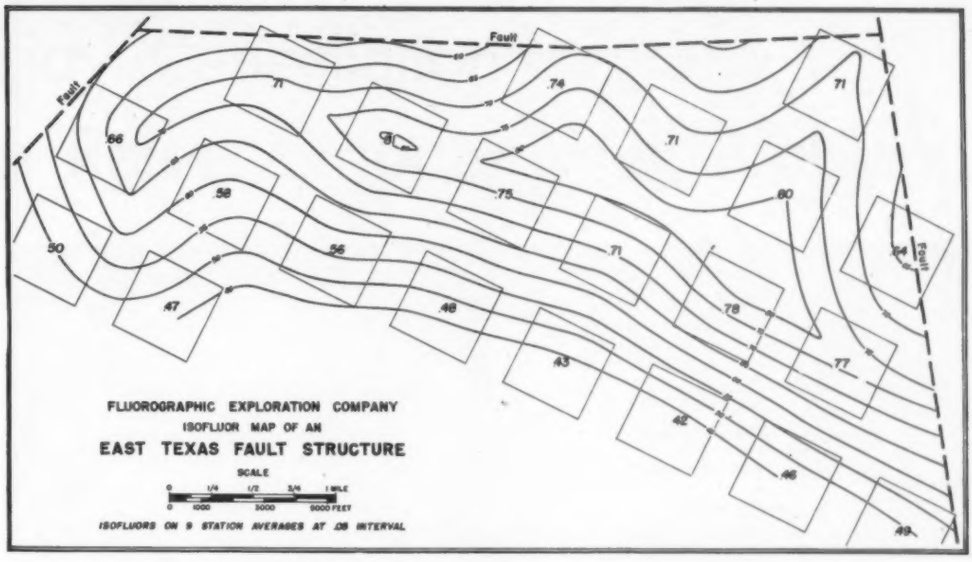
[1]Geologist, Fluorographic Exploration Co., Houston, Texas.

the problem at hand and the type of pattern developed. The type of pattern varies with the conditions causing the accumulations and to some extent with the region of the survey.

A stratigraphic accumulation develops the simplest type of pattern. Accumulation trapped by porosity conditions, sand lensing and pinchouts have been mapped, and these are easily recognized by their characteristic forms and their simplicity. In most cases of stratigraphic accumulation the area of local closure coincides with the producing area, with ten to fifteen percent of the production being outside, but marginal to, the closure. A fluorescent map of the Griffin Pool in Jones County, Texas (see Map No. 1) illustrates the results obtained over an accumulation trapped by difference in porosity in a lime reef formation. Note that nearly all the wells farthest from the anomaly, which were orginally completed as producers, have been abandoned. The Griffin anomaly is a so-called fluorescent minimum. The subject of fluorescent maxima and minima is discussed later in this article.

Accumulations trapped by faults and simple structures develop fluorescent patterns that disclose the type of structure. The isofluor map of an undeveloped East Texas fault trap, shown on Map. No. 2 is a good example of such a pattern. The data contoured on nine-station averages shows the outline, the axis, and the highest point on the structure, as it would be shown by other geophysical methods. The presence and the locations of the faults are determined by data on individual stations as shown on Map No. 3. Sharp differences in fluorscent intensity between adjacent stations along the indicated faults disclose their presence and positions. The contrast in intensity on and off the fault block is emphasized by shading the area where the fluorescent intensity is above .60. Over the fault block only three stations show an intensity of less than .60, while outside the fault block very few stations show an intensity above .60. This prospect is the usual type and it has the correct position for the area in which it is found.

Every significant fluorescent anomaly is a maximum anomaly compared to the local background. The fact is not always obvious, since on some anomalies the area of the highest fluorescent intensity is not found directly over the oil reservoir but around it. But the significant fact is the occurrence of high fluorescent intensity, whether it be over or around the accumulation. Insignificant minima, without high rims, are often found in the regional background. Certain provinces, South Texas for instance, develop only maximum anomalies, certain other provinces either type or combinations of the two types are encountered. The occurrence of the rim-minimum



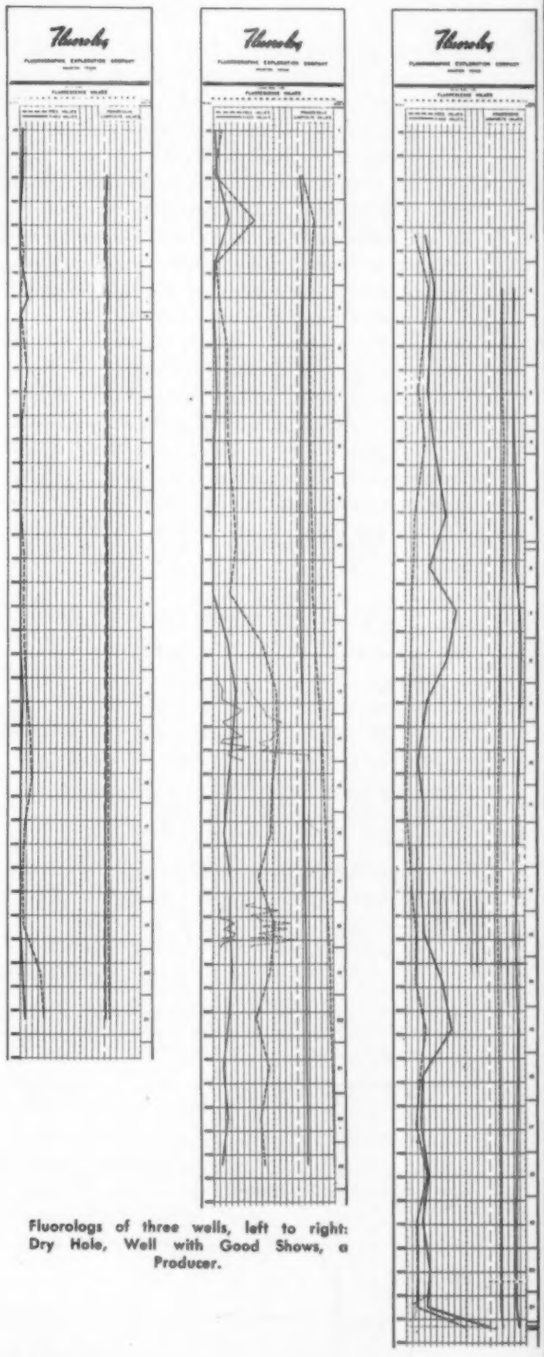
Map 2. Isofluor map of an undeveloped East Texas fault trap.

pattern over stratigraphic traps or simple structures causes no concern, since experience shows that the isofluoric closure, whether it be a maximum or a minimum, over a simple reservoir outlines the area of accumulation. Over complex structures the occurrence of a rim-minimum pattern, increases the difficulties of interpretation but fortunately such situations are encountered on a small minority of surveys.

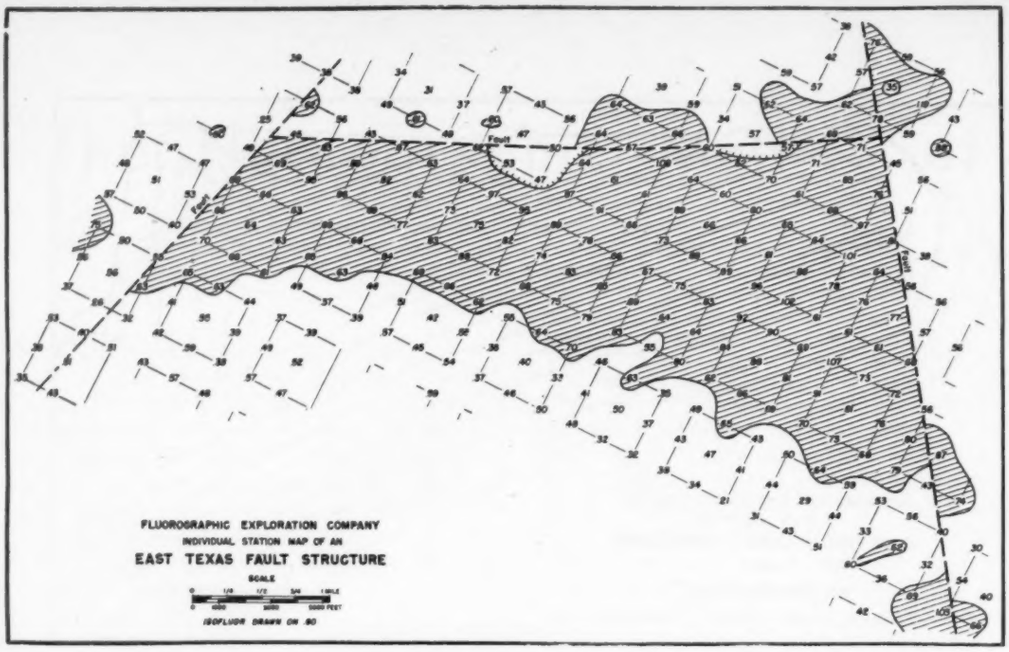
If a fluorescent anomaly is of the minimum-rim type, the width of the rim is to some extent directly proportional to the magnitude of the accumulation. The Heidelberg Field, Jasper County, Mississippi, (see Map No. 4) is located on a fluorescent anomaly of the maximum-rim type, which covers an area of about one hundred and twenty square miles. The Heidelberg structure is known to be an important reservoir. The average minor reservoir, North Delhi, in Harris County, Texas, for instance, develops a minimum-rim pattern covering about twenty square miles. Hence, the fact that maximum fluorescent intensity often occurs around, and not over, an accumulation, is turned to an advantage in estimating the importance of the reservoir. The Heidelberg fluorescent map is contoured on twenty-five station averages, hence it represents a generalized interpretation.

The fault block shown on Map No. 3 is obvious, due to the influence of the faults on the distribution of the fluoresent intensity of the surface rocks. It is generally true that the details of fluorescent pattern over a structural trap are genetically related to corresponding features of the structure itself. Hence, a close study of the fluorescent pattern generally leads to sound conclusions concerning structural details.

The average maximum cost of laboratory and interpretative work on fluorescent surveys is seventy dollars per square mile.



Fluorologs of three wells, left to right: Dry Hole, Well with Good Shows, a Producer.

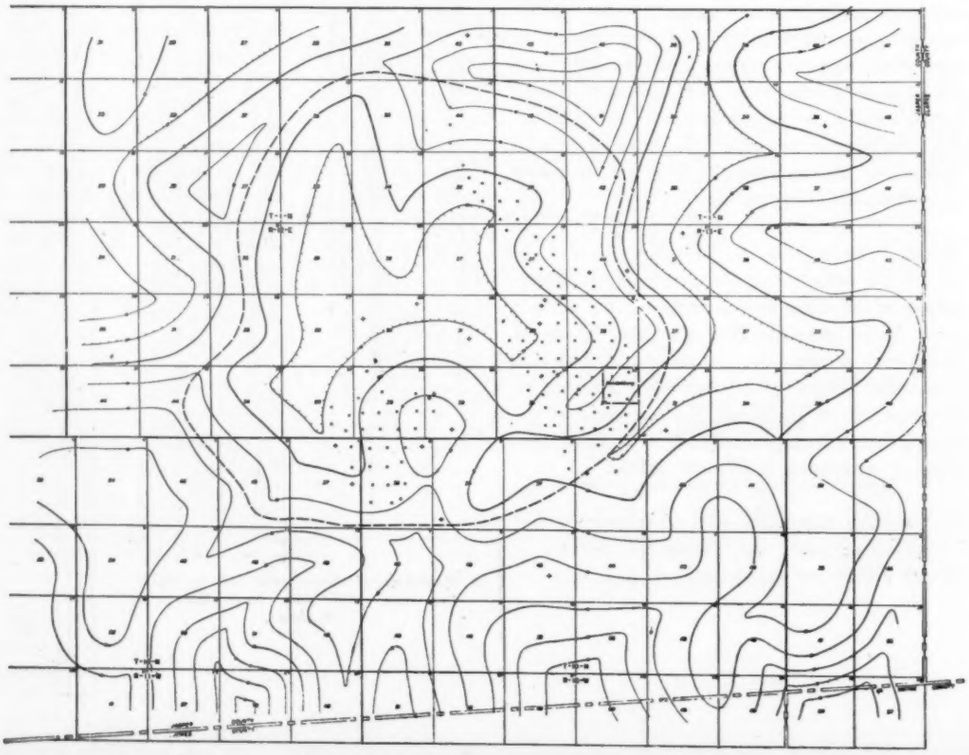


Map 3. Presence and location of faults disclosed by sharp differences in fluorescent intensity.

Flourescent data from well samples are plotted as curves on Fluorologs (see Fig. No. 1). Cuttings, samples taken at intervals of ten to thirty feet supply sufficient material, but it is desirable to analyze all cores available. The samples may be from drilling wells or old wells drilled years ago. For practical and economic reasons analyses of composite samples suffice until a show is encountered. A composite sample is prepared by mixing proportinate parts of the samples from two hundred feet of hole. If the fluorescent intensity of the composite sample shows a critical value, the several samples combined in the composite sample are analyzed separately to obtain detail data. All samples are analyzed for two types of data, referred to as "fixed" and "free" fluorescence. The fixed data are obtained from the sample material, and the free data from the free oil and gas found in the samples. A Fluorolog shows curves on the composite and detail data, for both fixed and free, on the left-hand side of the log. The two curves on the right-hand side of the log show the progressive average fluorescent intensity, fixed and free, at any depth of the well.

The Three Fluorologs shown in Figure 1, are, from left to right respectively, the fluorescent logs of a dry hole, a well that had good shows, and a well completed for a producer. The dry hole was drilled in the general area of a producing field but some distance from the field. It had no noteworthy shows, and the fluorescent intensity values remain near zero throughout the well. The well represented by the Fluorolog second from the left was drilled in the same area, but on the flank of the producing field. This well had some good shows. The shows, and the proximity of a commercial reservoir, are shown by the sub-critical intensity values recorded, but a low progressive average on the fixed fluorescent intensity indicates no commercial production in the well or at greater depths. The Fluorolog on the right is of a well, located in another area, which was completed as an oil well, on recommendations based on the Fluorolog. This well shows a high fixed fluorescent intensity from top to bottom, and progressive increase in free fluorescent intensity with depth. The Fluorologs shown are typical of fluorescent logs in general. Fluorologs of dry holes, some drilled to depths of ten to twelve thousand feet, show very low fluorescent intensities and no appreciable increase with depth. Fluorologs of dry holes, drilled near production, indicate the proximity of a reservoir by a sub-critical intensity values, in the horizons of the nearly production but they do not maintain a progressive increase of fluorescent intensities with depth. Samples from a well drilled into a commercial reservoir show a progressive increase in fluorescent intensity as the source of the samples approaches the reservoir, and the fluorescent intensity reaches a maximum value in samples of the reservoir rock. Hence fluorescent data indicate, locate, and evaluate shows and pays in a drill hole, they detect the presence of commercial accumulation laterally from the drill hole, and they anticipate a pay ahead of the drill bit. The average cost of fluorescent logs is five cents per foot of hole.

Map 4. The Heidelberg Field, Jasper County, Mississippi, is an example of maximum-ring type fluorescent anomaly.



The evidence at hand on fluorescent data, from the surface and subsurface, clearly indicates that an accumulation of petroleum is associated with, and characterized by, a three-dimensional anomaly in the fluorescent intensity of the rocks overlying and adjacent to it. Hence, the working theory of the fluorescent method is that anomalous fluorescence of surface and subsurface rocks is generally related to, and significant of, an adjacent or subjacent petroleum reservoir. Moreover, fluorescent data is quantitative as well as qualitive, and fully applicable to the problems of petroleum exploration since fluorescent maps disclose both form and structure of petroleum traps.

The fluorescent method has already earned for itself a place in the present program of petroleum research. It is a direct method of finding oil, and is peculiarly adapted to the heretofore solved problems of discovering the oil and gas, estimated by geologists to be great in quantity, long hidden in stratigraphic traps. The economy of fluorescent prospecting, its adaptability to structural as well as stratigraphic problems, and its availability on all kinds of terrain, makes it a hardy competitor in any theater of exploration. Fluorescent data contributes important information not supplied by other methods and it can be profitably used along with other methods. Taken by itself or with other geophysical data, fluorescent intensity is a good sign of game that oil hunters can learn and follow to the benefit of the industry and to the glory of their personal trophy rooms.

Prospective Subsidy Cancellation Again Raises Stripper Well Problem

BY E. G. DAHLGREN

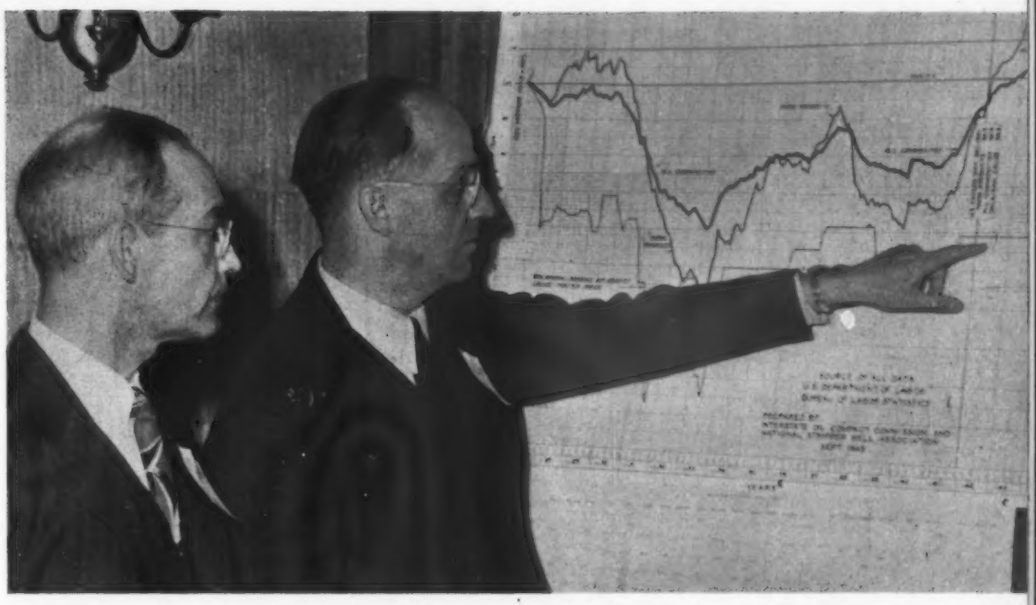
THE office of Economic Stablization recently announced that government subsidy payments on stripper well production will continue until June 30, 1946, unless price ceilings are lifted prior to that date. As a result of the present uncertainty, operators are holding back secondary recovery projects until they know definitely the economic outlook. The stripper well problem thus presents itself anew as one which demands solution in the interests of conservation. Without an equitable solution the trend of abandonments will rise again and millions of barrels of known reserves will be lost.

The National Stripper Well Survey for 1944, a joint project of the Interstate Oil Compact Commission and the National Stripper Well Association, was released in December, 1945 at the Compact's winter quarterly meeting at Wichita, Kansas. Two prior surveys were made jointly for 1941 and 1942. A stripper well, in the surveys, was defined as a well whose production expenses approximates income. Under this definition a deep well with substantial production could be classified as a stripper well.

Out of the 412,851 oil wells in the United States on Jan. 1, 1945, a total of 296,388 wells or 71.8 percent are classified as stripper wells in the report. In 1944 these wells produced 217,041,621 barrels of oil or 12.9 percent of the total United States output. The total nearly equalled the combined production of Oklahoma and Kansas. Average daily production of all wells during 1944 was 11.1 barrels with stripper wells averaging 2 barrels per day.

Producing stripper wells increased 3,107 between 1942 and 1944 and produced 14 million barrels more in 1944 than 1942. This additional oil was a great war aid when flush and semi-flush wells were being produced above maximum efficiency. The number of wells abandoned in 1944 was 1,141 less than in 1942. In 1944 abandoned wells contained 34 million barrels of recoverable oil compared to 44 million barrels in 1942.

Stripper operators patriotically kept many wells in operation during the war after their economic limit had been reached even with subsidies. With labor scarcity and lack of adequate equipment presenting difficult production problems, coupled with rising production costs and higher personal living costs, stripper well operators were in a tight squeeze.



"Ty" Dahlgren, the Author, pointing out to George Pasquella, consulating engineer, how oil prices have failed to rise with other commodities.

Federal compensatory payments were begun on August 1, 1944. In pools averaging less than 9 barrels per well per day, 20 cents per barrel was paid; pools averaging less than 7 barrels, 25 cents per barrel; and 35 cents per barrel for pools averaging less than 5 barrels. A flat 75 cents per barrel was given to pools producing Pennsylvania grade crude in Pennsylvania, New York, Ohio, and West Virginia. This additional income provided necessary funds for reconditioning and cleaning out wells and replacement of some of the worn out equipment.

Many producers feel that it now is more important than ever to safeguard the stripper well reserves as many flush oil fields lost a substantial part of their reserves by high rates of production to meet wartime requirements. Secondary recovery projects were not expanded to any great degree during the war on account of the acute shortage of pumps and compressors.

The stripper survey revealed that an estimated 337,031,550 barrels of oil can be produced by secondary recovery means with a 25-cent increase in price. With a 50-cent advance 979,728,575 barrels can be produced by secondary recovery and by increasing the price to 75 cents above present levels it was estimated that 1,651,815,950 barrels can be recovered. Additional reserves clearly can be obtained with the proper price incentive to warrant installation of costly water flooding and gas repressuring equipment. Some authorities state that between three and four billion barrels of oil can be recovered by secondary recovery methods. With declining discovery rates and fewer oil pools to be found, this second crop of oil cannot be ignored.

The Independent Petroleum Association of America has published a tabulation of stripper well subsidies for eleven months ending July 1, 1945 showing $49,822,347 had been paid in subsidies for 136,788,408 barrels of oil, an average of 36.5 cents per barrel. A daily average of 409,832 barrels received the benefit of the subsidy which averaged $149,020 per day. Eight and one-half percent of the nation's oil production received the subsidy. Oklahoma producers were paid $10,598,109 or 31.5 cents a barrel for 33,688,739 barrels. Daily average was 100,864 barrels. With a gross production tax of 5% the state of Oklahoma also benefitted to a large degree. Texas and Kansas ranked second and third respectively in the benefits of the subsidy.

The conservation department of the Oklahoma Corporation Commision aided stripper well operators in determining eligibility for payments. With the inauguration of the subsidy, the commission certified a list of pools or fields and has aided continuously since. The Kansas Corporation Commission and other state regulatory agencies also function in a similar manner.

↑ Oklahoma's first oil well in Johnstone Park, Bartlesville, still is pumping.

↑↓ Central power on a typical North Texas lease in the Petrolia field. This 40-year-old lease has 32 wells producing 0.5 barrel per well per day.

In pools with average production costs above crude ceiling prices, the OPA has permitted applications for "hardship" subsidy payments. For example, if a pool has a production cost of 75 cents per barrel, this is added to an arbitrary of 60 cents to cover depreciation, overhead, etc., to arrive at a total of $1.35. With a field price of $1.17, the difference of 18 cents is allowed as subsidy. Complete affidavits must be submitted to support application. Pools in many states receive this type of subsidy.

One of the most typical stripper well areas is the region adjacent to Wichita Falls where over half of the Texas stripper wells are concentrated in Archer, Baylor, Clay, Cooke, Foard, Jack, Montague, Wichita, Wilbarger, and Young counties. The oil industry in North Texas dates back to 1904 when oil was found in Clay county. The Electra field discovery well in Wichita county in 1911 started intensive exploratory work. Oil is now being produced from depths varying between 400 to 7,000 feet in all counties in the district.

At the present North Texas has over 3,000 leases with 16,200 stripper wells producing an average of 2½ barrels per day, an annual total of 14,780,000 barrels. With a posted price averaging $1.21 per barrel (38 gravity crude), revenue totals $17,883,000 a year. This marginal production is owned largely by 700 independent operators who live in the area and directly employ over 3,200 men. The economic life of the citizenship in the ten county area is mainly dependent on oil and the revenues contribute largely to the support of the schools, churches, and government.

Although secondary recovery by gas repressuring has been in operation for many years in North Texas only a few highly successful water flood projects have been in operation. Millions of barrels of oil in the depleted and semi-depleted oil pools of North Texas could be recovered by the expansion of secondary recovery methods if an adequate price for oil is made available to justify the large initial investment in equipment.

Fred Sehmann, executive vice president, North Texas Oil and Gas Association, Wichita Falls and secretary-treasurer of the National Stripper Well Association, states as follows: "If a favorable price adjustment is not forthcoming in the near future and the present stripper subsidy removed, it will result in the premature abandonment of many small wells which have been kept on the pump only with the aid of compensatory payments."

An examination of the producing oil wells in Michigan during December, 1945 showed 2,600 wells in pools producing an average of less than 9 barrels a day or 73% of the state's total of 3,521 wells. In December Michigan oil wells produced a daily average of 44,244 barrels or 12.6 barrels per day per well.

Many operators feel that a payment on oil produced from stripper wells should be made permanent as a conservation measure. With the transition from a war economy to a peace economy. the preservation of stripper wells barely eking out an existence presents a problem which must be solved quickly.

Using Osage county near Tulsa, Oklahoma as an example, it is estimated that the oil pools in the county would have a reserve of 300 million barrels with an adequate price instead of the 60 million barrel reserve at present prices. The water flood possibilities of the once famed Burbank field east of Ponca City indicates a possible reserve of approximately 200 million barrels.

The policy of the Indian Agency in Osage County is that no well may be plugged if it pays operating costs. Even with this rather harsh policy 606 wells were plugged from January 1, 1942 to August 1, 1944 when the conservation payment or subsidy became effective. The plugging average was 19.5 wells per month. From August 1, 1944, after the conservation payment started, to Sept. 1, 1945, only 145 well were plugged or an average of 11.15 wells per month. During the first eight months of 1945 only 52 wells were plugged for an average of 6.5 per month.

It has been stated that stripper well subsidies cost the government nothing, since federal agencies receive more taxes from gasoline, lubricating oil, and pipe line transportation taxes than is paid out in subsidies. If the subsidy is withdrawn and stripper wells abandoned, the federal government will not receive the moneys accruing from taxes on stripper production. The states will also lose revenue from gasoline and gross production taxes, particularly in Texas and Oklahoma, where the taxes on the oil industry produce a large portion of the state revenues. Many operators favor a permanent price differential for stripper well production. They think the price differential should supplement the general price advance needed by the production branch. Subsidies are repugnant to many oil producers who desire that the law of supply and demand function. Several plans have been suggested to protect the future of stripper wells. An excise tax on crude might be levied by the federal government for use by stripper operators on a per barrel basis under a formula which would consider productive rate, depth, or cost of the wells. Another plan would be a subsidy paid by the U. S. Treasury from general funds. A third plan would be the imposition of a federal tax on gasoline. A fourth plan would be a tax on all imported crude oil and products. Still another plan would tax crude oil transportation. One more plan would be a levy on all crude and product exports.

There are many arguments against a permanent subsidy. Many feel that it would mean complete subsidization for the producing branch of the oil industry, since every oil completion would eventually come into the stripper group. Also many feel there is no sound economic justfication for any industry to be required to resort to a subsidy because an artificial price ceiling forces its product on the market at below-cost figures.

↑ With proper price differentials producers can equip stripper wells with modern pumping units such as this Phillips Petroleum Co. well in Osage County, Oklahoma.

The ideal solution to the whole problem of stripper wells would be a high enough price increase for all oil production. The industry needs a substantial increase because it was enduring a period of crude prices when wartime price controls were instituted in the latter part of 1941.

The price index chart, prepared for the 1944 National Stripper Well Survey report, vividly portrays the relationship of the price of 33 gravity Oklahoma-Kansas crude oil in comparison with the indices of all commodities and farm products. The Oklahoma-Kansas crude oil index has been frozen at 58.9 since before December, 1941 when we entered the war; U. S. crude as a whole is frozen at 62% of the 1926 prices; while the index of all commodities moved upward from 93.6 to 105.7. The farm products index moved from 94.7 to 126.9, a gain of more than 32 points. The price of Oklahoma-Kansas crude would be $2.13 per barrel to equal the rise of the all commodities index, while a price of $2.53 a barrel would be necessary to equal the rise enjoyed by the farm products index. The January, 1946 issue of the Monthly Labor Review shows the November, 1945 index of all commodities at 106.8 with the farm products index at 131.1.

The average individual does not realize what a cheap commodity crude oil is in comparison with other commodities. Crude oil at $1.25 per barrel costs 3 cents a gallon or ¾ cent per quart. Milk is worth about 14 cents a quart, beer 35 cents a quart, Coca Cola 27 cents. Ordinary tap water at 1/40 cent per quart is perhaps one of the few liquids that is cheaper than oil.

Crude oil is worth 44/100 of a cent per pound. Ordinary table salt, which is usually considered a cheap commodity, sells for 14 times as much as crude oil. Other commodities on a pound basis include butter at 55 cents, cattle at 15 cents, hogs 14 cents, and cotton at 21 cents.

As oil is considered an irreplaceable commodity, it is ludicrous to consider its low value in comparison with its benefits to mankind. The thousands of stripper well operators in the oil producing states fervently hope that a solution will soon be forthcoming to recognize the plight of the "old folks" of the oil industry who are doing their share to make our nation great.

Colorado No. 9 in the De Mares Concession Was Drilled to 4500 Feet to a New Horizon in an Old Structure.

COLOMBIA

Looks to Increased Activities

IN spite of conditions imposed by the war, including transportation shortages and difficulties in obtaining equipment, 1945 was a year of great activity in the Colombian oil industry. Exploration was on a larger scale, well completions increased and applications for concessions covered a greater area than in other recent years. On the basis of projected operations by established companies and interest displayed by newcomers 1946 will be marked by still further expansion. While it was stated by the Minister of Petroleum that the granting of further concessions had been suspended pending action by Congress on the proposed amendment of the oil law there seems to be a good chance of the bill's enactment at the next session.

During the past twelve months 72 wells were spudded on eight different concessions. Sixty-three were completed, 47 of them as producers. The largest number of wells put down were in the Infantes and La Cira fields of the Tropical Oil Company in the De Mares concession where 19 were completed, all productive. In addition Galan No. 1 and No. 3 brought in by the same company proved an extension of the Casabe field and a third well, Colorado 9, was completed, giving the company a total of 22 for the year. Shell's Casabe field of the Yondo concession also was the scene of active drilling with nine producing wells completed and the same company added six producers in the Dificil field further north in Magdalena. Socony-Vacuum brought in a well, Cantagallo No. 6, on the western side of the Magdalena River in Antioquia. On the Barco concession of Texas-Socony nine of the twelve wells spudded reached successful completion.

On January 1, 1946 the number of wildcats under way was 34 as compared with 24 one year earlier. In the Tabú field of the Barco two deep tests are progressing while four other locations are in various stages of preparation. Socony-Vacuum has several tests under way at Floresante. At Cantagallo rigging up is progressing at one location and drilling is going forward on another well that was spudded in December. At El Pedral, east of Cantagallo, a depth of 7,800 feet had been reached at the beginning of the year.

On a tract at Teran-Guaguaqui in the Magdalena Valley owned in fee by The Texas Company, a test well, Velasquez No. 1, has been begun. The same company is preparing the site for another test at El Tablon, further north in Bolivar. A road is being built and a camp site prepared. Several interesting tests are under way in the Caribbean area by Tropical, Richmond and Socony-Vacuum. A promising prospect is Costarica where a deep test is now below 5,000 feet. This tract is held by Petroleos Ariguani, jointly owned by Tropical and Colombian interests. Special interest has attached to Shell's exploratory work in the Llanos. Its first test, San Martin No. 1, was completed as a water well. Drilling on San Martin No. 3 had reached nearly 7000 feet at latest report.

↑ Tank Farm at Coveñas Consisting of Ten 118,000-Barrel Tanks Behind Staff Quarters. Part of 5-story Office Building is seen in Foreground.

Texas 130-Ton Barges Under Construction for Magdalena River Work at Barranquilla Boatyard. →

Four Million Barrels of Crude Was Pumped Through the 20-inch Line at the Caveñas terminal of the 261-mile Sagoc Pipe Line from the Barco Concession in 1945. ↓

Four North American oil companies entered Colombia during the past year. Tri-Pet Corporation, organized by Cities Service, Sinclair and Richfield, has established headquarters at Bogota as a preliminary to acquiring concessions. Phillips Colombian Oil Company also entered the country during the year. This brings to ten the number of major companies active in Colombia. Representatives of others have visited the country looking over the possibility of future entry.

Applications for concessions during the past year numbered 93 covering approximately 16,000,000 acres. Of these 13 were accepted by the Ministry of Petroleum and grants were made of five to the following companies: Socony-Vacuum, Texas, Richmond, Ariguani and Gulf.

An important addition during 1945 to Colombia's fields producing oil for export was Casabe from which pipe line shipments began in June last. Another growing field is El Dificil which at the beginning of this year had seven producers capable of yielding 3,000 barrels per day of 45° API oil.

Production of crude oil during the past year with December estimated was approximately 22,630,000 barrels as compared with 22,647,478 barrels in 1944. Of the production 15,560,000 barrels or 69 percent came from the De Mares concession, 5,450,000 barrels or 24 percent from the Barco and 1,530,000 barrels or seven percent from Shell's Yondo concession.

VENEZUELA PRODUCTION Sets New Record in 1945

Activity Will Continue at Accelerated Rate in 1946 to Enable Oil Companies to Select Acreage for Future Development Within Period Allowed By Law.

BY ANNE NEWMAN SUTTON

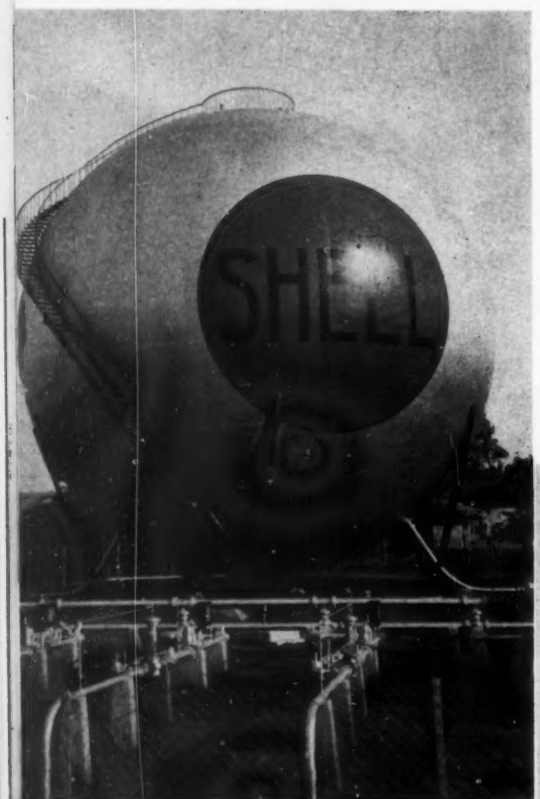
DURING 1945, Venezuela experienced the most active year in its petroleum history and established an all-time production record of 323,359,000 barrels of oil, an increase of 66,325,000 barrels over 1944. At year's end, the country was producing about 13 percent of the world's oil, and ignoring Russia whose production is unknown, stood second among the oil producing nations of the world.

Venezuela's production rose steadily throughout the year from 765,659 barrels per day during the week ending January 8 to 1,020,451 barrels per day during the week ending November 12 when production reached its all-time peak. The decline for the remainder of the year, as shown in Fig. 1, was nominal. The close of the war with Japan last August did not interrupt the rise in production. Western Venezuela produced 218,492,000 barrels, and Eastern Venezuela 104,868,000 barrels in 1945. The Bolivar Coastal field of the Maracaibo basin, one of the world's outstanding fields, was the greatest single contributing area. It furnished 186,862,000 barrels or approximately 57.8 percent of the country's total. Table I shows Venezuela's production by companies.

The phenomenal increase was stimulated by war demand. Other contributing factors were the elimination from world markets of the Netherlands East Indies supplies and those of Central Europe, and the curtailment of production in the Near East. Increased demand for Venezuelan oil began in 1940 after the outbreak of war in Europe and continued through 1941. Enemy submarine activities in the Caribbean curtailed production in 1942 and 1943. After this was brought under control, production and shipments resumed their upward trend.

Accelerated drilling programs were carried out

↓ Caribbean Petroleum Co. pressure storage at Maracaibo.



↓ Caissons and Piles are welded and coated with cement at LaSalina before use.

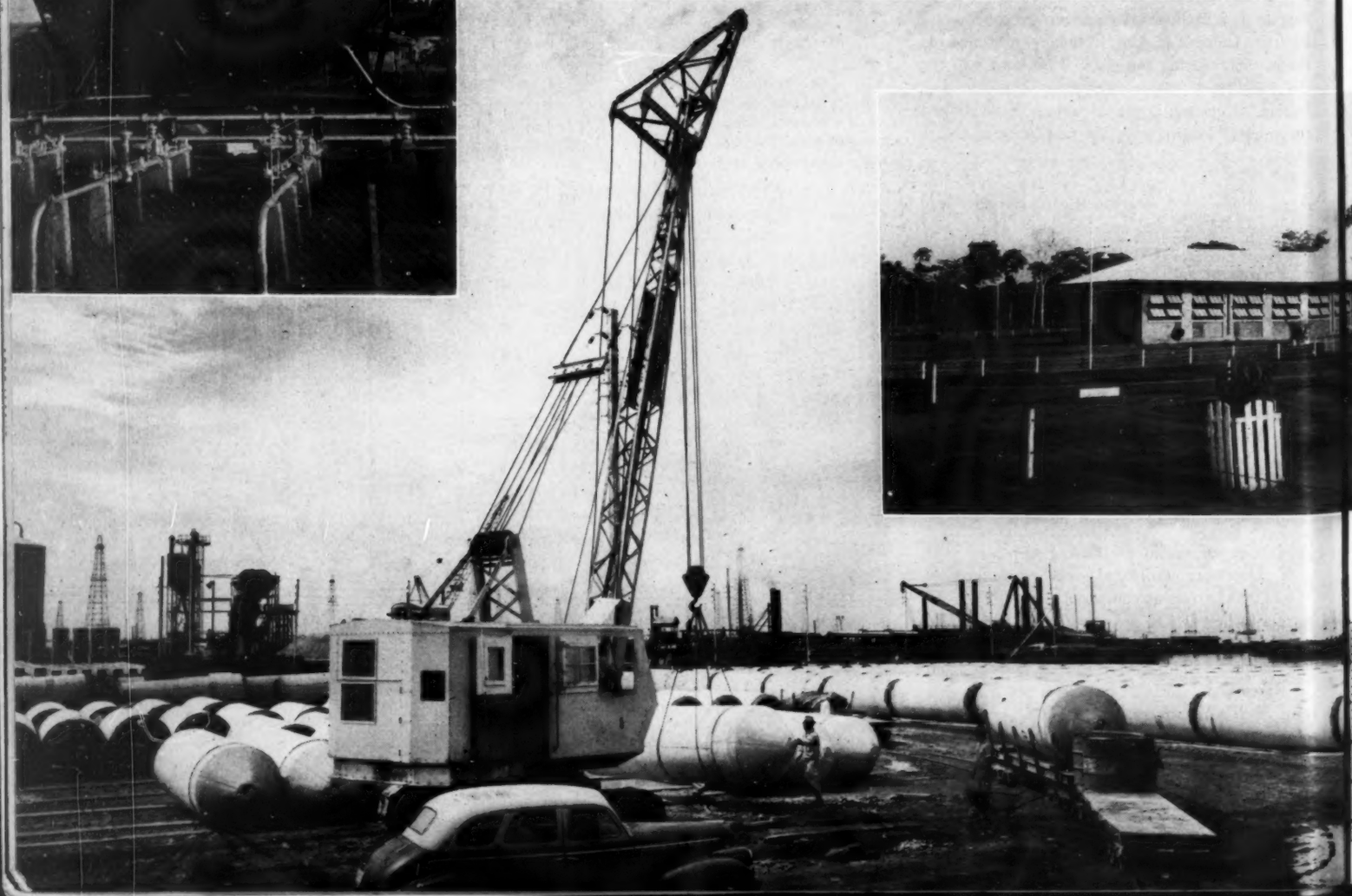


Table I

Venezuela's 1944 And 1945 Production By Companies

Company	Production In Barrels		Percent Of
	1944	1945	1945 Total
Creole Petroleum Corp.	141,341,000	171,595,000	53.10
Shell Group	64,285,000	81,452,000	25.20
Mene Grande Oil Co.	39,108,000	54,483,000	16.80
Consolidated Oil Co.	10,618,000	10,449,000	3.20
Socony-Vacuum Oil Co.	1,027,000	4,087,000	1.30
All Others	655,000	1,293,000	0.40
Total	257,034,000	323,359,000	100.00

by the major producing companies in 1945. A total of 533 wells were drilled, 403 in Eastern Venezuela and 130 in Western Venezuela. Development wells in proven fields totaled 483 and 85 exploration wells were drilled. Activity in Eastern Venezuela was centered largely in the Jusepin-Mulata and Guara fields. In the Jusepin-Mulata field, Creole drilled 163 wells. Of these, 135 were routine completions and 28 were exploratory to test deeper horizons and expand the limits of the known producing areas. In the Maracaibo basin area, Creole completed 56 wells in the Bolivar Coastal field.

Activities of the Shell Group were confined exclusively to the Maracaibo basin with 64 development wells and 6 wildcats. One of these, R-801, located in the Cabimas district of the Bolivar Coastal field, was suspended at a depth of 13,034 feet, and is the deepest well in South America. A new field was discovered by Shell in the district of Mara, approximately 28 miles northwest of the city of Maracaibo. Oil was found in the Cretaceous limestone at 6,000 feet. The field is in its initial development stage and no reliable estimate can be made concerning the extent. As an outlet, Shell constructed a 12-inch, 18-mile, pipe line, from the field to Palmarejo on the lake shore.

Mene Grande Oil Co. drilled a total of 119 wells, all but four of which were located in Eastern Venezuela with greatest activity in the Guara and Travieso areas.

Socony's exploitation drilling was confined to the Guico and Guario fields in Anzoategui where 17 oil wells were completed. In addition, San Vicente No. 1, a wild cat, was drilled on a large block in Barinas.

Consolidated's activities were limited to the Santa Barbara and Muri fields in Monagas where 64 wells were completed as producers.

The Texas Co. completed two oil wells in the Rincon section of the Santa Ana field of Anzoategui and four in the Tucupita area of the Delta Amacuro. Las Mercedes Petroleum Co., an affiliated organization, completed a number of wells in their Las Mercedes field of north central Guarico.

Four exploratory wells were drilled by the Venezuelan Atlantic Refining Co. in the state of Monagas. Of these, three were dry and one was a producer.

Phillips Petroleum Co. drilled a number of geologic test holes in Northern Monagas.

North Venezuelan Petroleum Co. carried out extensive geological studies on its 988,400-acre exploration block in the state of Falcon but did not drill any wells.

The extensive exploration initiated by the major companies in 1945 will be expanded in 1946. Under the petroleum law of March 13, 1943, the holders of exploration concessions have a period of three years in which to select not more than 50 percent of their exploration acreage to be retained as exploitation acreage, the remainder to revert to the government as national reserves. In most instances, less than two years remain in which to make the final selections and all companies are working against this time limit.

Creole's exploratory efforts in 1946 will be confined largely to the northern part of the state of Guarico in north central Venezuela where they hold two large exploration blocks totalling 784,275 acres. In addition, exploration will be carried out in Northern Monagas and Western Venezuela. Plans call for the employment of four seismograph parties, three gravimeter parties and two to three surface geological parties.

In connection with the exploration program of the various companies in Northern Guarico, construction was begun in 1945 on a 187-mile improved motor highway which will extend from El Sombrero eastward through Northern Guarico and Northern Anzoategui to Puerto La Cruz, the pipe line terminal for a number of the eastern Venezuelan fields. The highway will be constructed jointly by companies whose properties will benefit. Creole has been named as the operator. Each company's participation in the cost will be based on the extent of its holdings and the accessibility to the main highway. Irrespective of benefits to the oil companies, the El Sombrero-Puerto La Cruz road will open up a large sparsely settled and almost inaccessible area and assist materially in the agricultural development of this section of Venezuela.

Table II

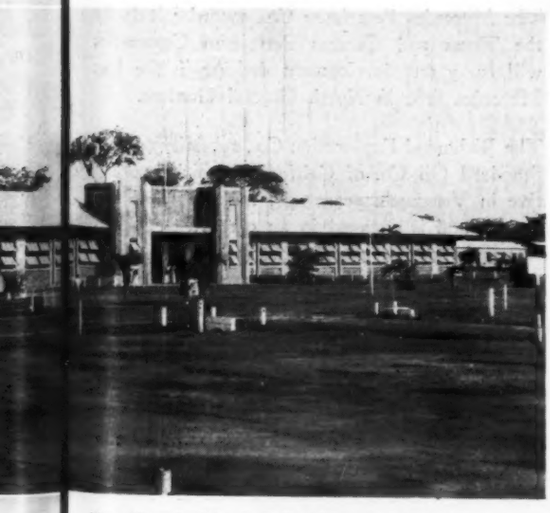
Venezuela's 6-Year Production Record

Year	Production Barrels
1940	186,134,000
1941	228,131,000
1942	147,984,000
1943	179,399,000
1944	257,034,000
1945	323,359,000

The Shell group's projected activities for 1946 will be concentrated largely in the Maracaibo basin area of Western Venezuela. It is estimated that 220 field wells will be drilled of which about 170 will be located in the Pueblo Viejo Tia Juana, and Bachaquero districts of the Bolivar Coastal field. The remaining wells will be drilled in the outlying Las Cruces, La Paz, Mene Grande, and Mara fields. Shell also contemplates commencing exploration drilling in Eastern Venezuela during 1946.

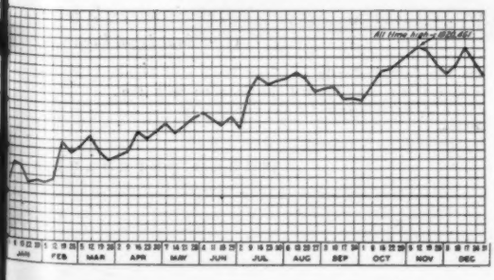
Exploration activity will be continued in the Maracaibo Lake basin, and also in Anzoategui, and Eastern Guarico in Eastern Venezuela. It is probable that six seismograph and two gravimeter parties will be operated throughout the entire year and about 12 exploratory wells will be drilled.

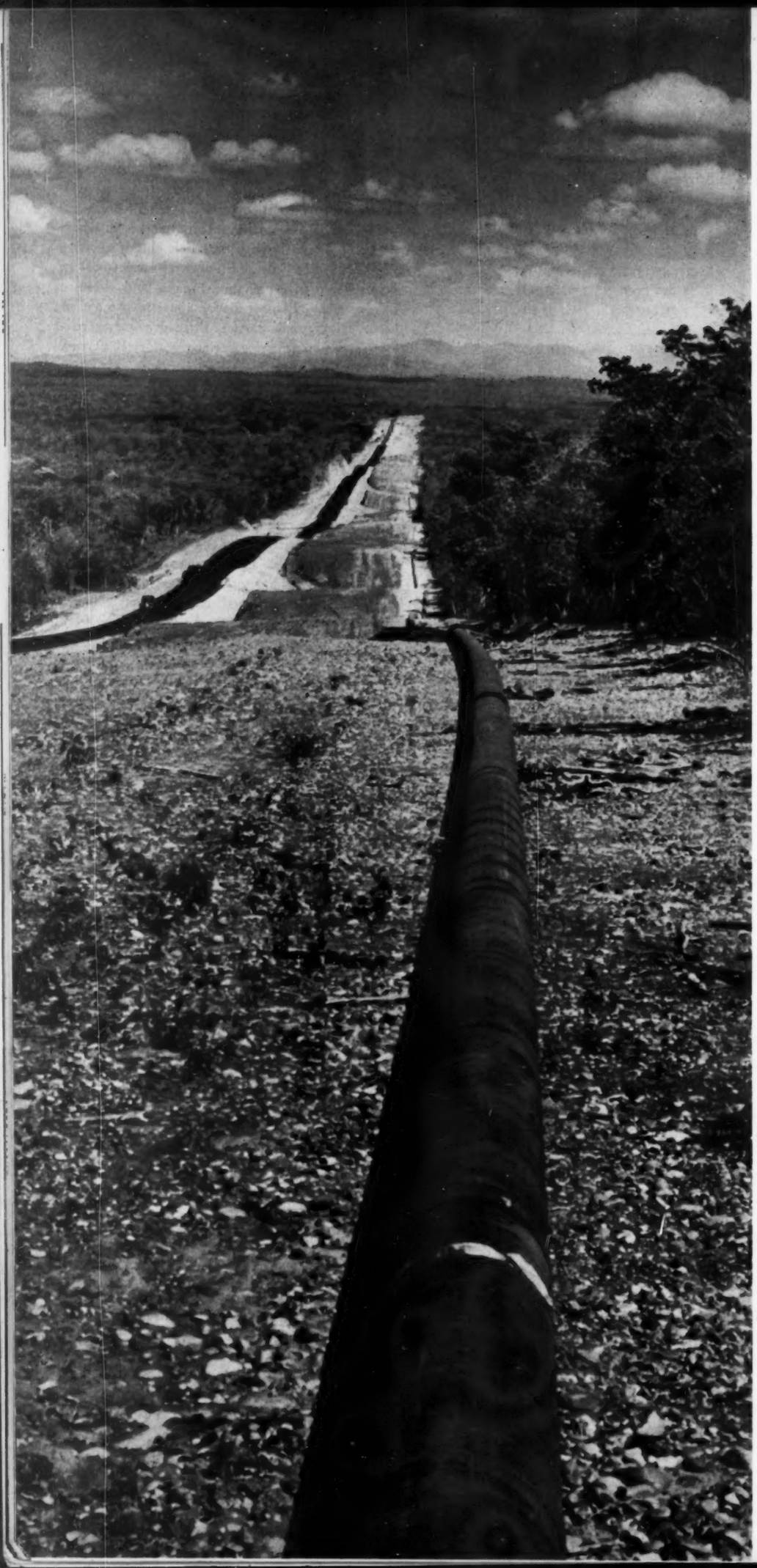
Construction of Shell's new 40,000-barrel Cardon refinery on the Paraguana Peninsula, which



Mene Grande School of Caribbean Petroleum Co.

VENEZUELA DAILY AVERAGE PRODUCTION
1945





was begun in 1945, will make considerable headway, as materials become available.

Mene Grande Oil Co.'s plans for 1946 call for the drilling of 118 development wells in Eastern Venezuela and 38 in Western Venezuela. The majority of the former will be located in the Guara and Travieso areas of Anzoategui and Monagas and the latter in the Pueblo Viejo-Bachaquero district of the Bolivar Coastal field.

Exploration will be carried out in the western states of Zulia and Apure, and the eastern states of Anzoategui and Monagas. Four seismograph and two gravimeter parties will be employed throughout the year and it is planned to drill 12 exploratory wells.

Five rigs will be employed by Socony-Vacuum throughout 1946 for field drilling in the Guario and Guico areas of Anzoategui, and at least one Diesel unit will be used for exploratory drilling in the states of Anzoategui and Monagas. The company's principal exploration activity, however, will be confined to the western Llanos Barinas area where Socony's exploration holdings comprise 3,212,300 acres. Five seismograph and one gravimeter party will carry out geophysical surveys and the two rigs which are currently drilling at San Silvestre No. 1 and Yaure No. 1 locations will continue as exploration units. A third heavier rig will be placed in operation later in the year if developments warrant.

The Texas Co. will continue its development and exploration efforts in the Tucupita areas of the Delta Amacuro and will probably utilize two to three rigs on exploratory drilling in northern Guarico.

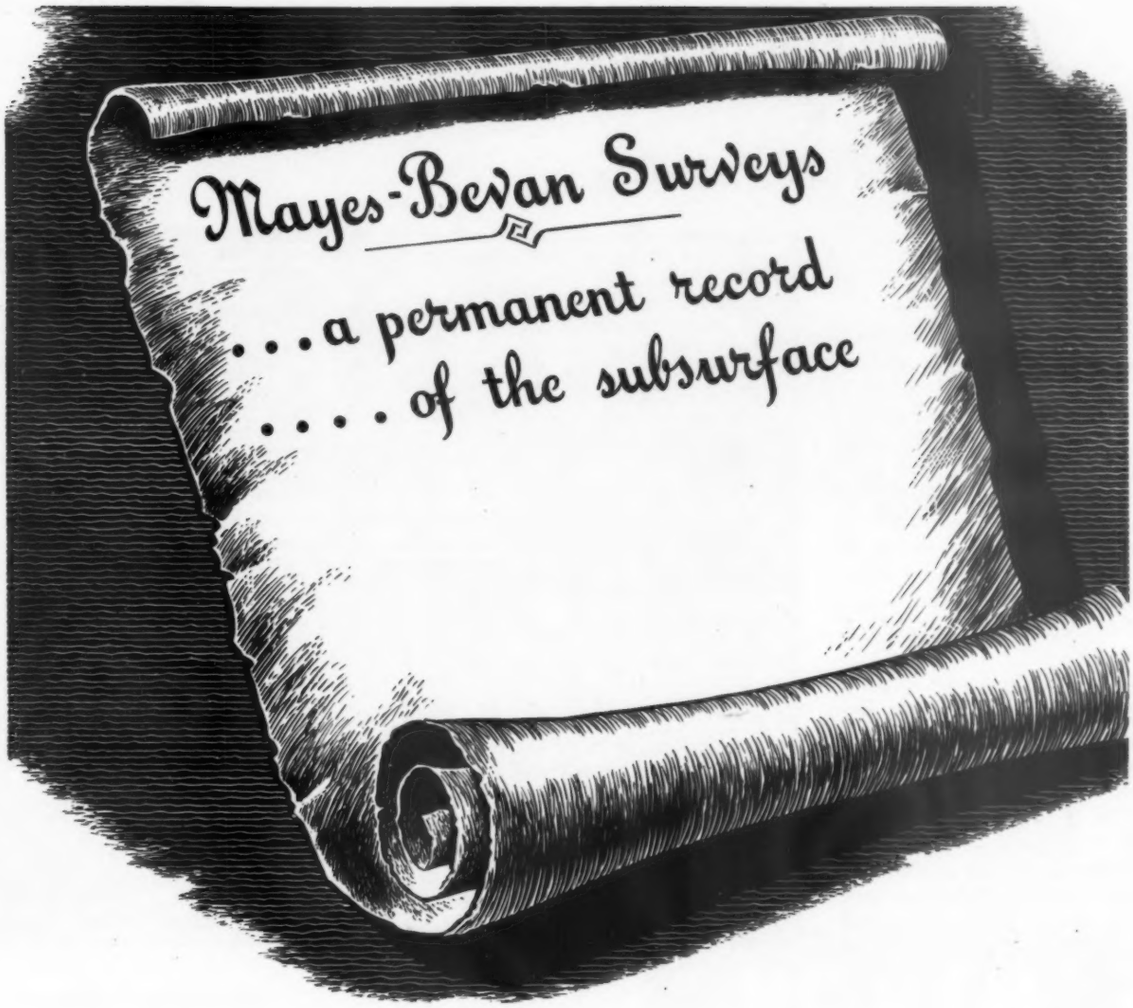
The Mercedes Petroleum Co., owned jointly by the Texas and Caracas Petroleum Companies will carry out development drilling in the Las Mercedes field in North Central Guarico.

The Richmond Exploration Co., subsidiary of the Standard Oil Co. of California, which was active in Venezuela years ago, has reentered the picture and is engaged in an extensive exploration program in the Maracaibo basin, Delta Amacuro, and Falcon. Its Western Venezuela holdings were acquired under the 1943 petroleum law and embrace an area of 1,771,707 acres in the Zulia districts of Urdaneta and Perija, and western Lake Maracaibo. The Delta concession comprises 901.915 acres. Richmond now is drilling two exploratory wells west of the lake. Additional drilling in Falcon depends upon the results of Montanita No. 1. An extensive exploration drilling program for 1946 will depend largely on the availability of necessary equipment. During this period, one geologic, two seismograph, and one gravimeter party will operate in Zulia and one seismograph party

(*Continued on Page 92*)

On the Jusepin-Puerto La Cruz Road and Pipeline; looking west toward the junction with the Oficina-Puerto La Cruz Highway.

←



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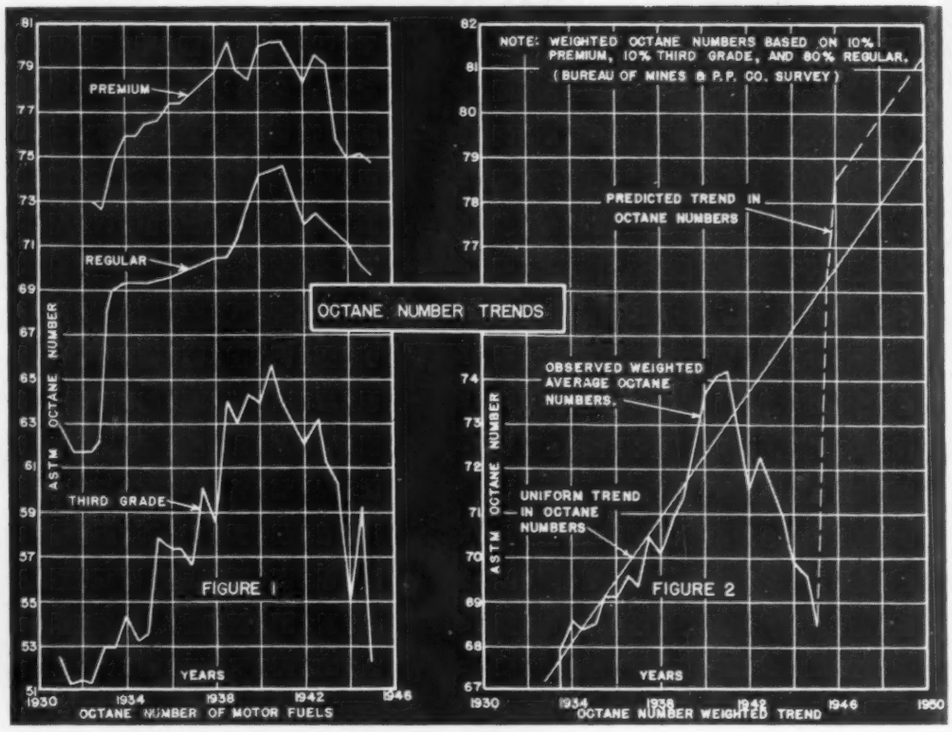
Octane Number Trends Of Motor Fuels

If the Knock Rating of Post-war Motor Fuel Resumes The Pre-War Trend, 1946 Gasoline in the United States Will Have an Average Octane Number in the 77-79 Range.

By

R. R. Couch and R. C. Alden*



THE cessation of hostilities with the resulting decrease in the requirements of the military services for large volumes of one hundred octane number aviation gasoline has shifted the emphasis in refining operations from avaiation gasolines to motor fuel. The full effect of this gasoversion program on motor fuel quality is not apparent at the moment but it is reasonable to expect that gradual quality improvements in motor fuel stocks will result once refinery operations are stablized and the full appraisal of new processes and refining innovations is completed.

In this connection it is of significance to recall the steady and gradual increase in motor fuel quality as exemplified by the octane number trends that prevailed for motor fuels marketed during the decade immediately preceding the start of World War II. These trends are presented graphically in Figures 1 and 2. The average octane numbers as shown in the chart for the three primary grades of motor fuels were derived from the Bureau of Mines semi-annual motor fuel surveys and from Phillips Petroleum Company's own motor fuel surveys. In arriving at the weighted average octane number trend shown in Figure 2, sales volume of 80 percent for regular or household, 10 percent for premium and 10 percent for third grade motor fuel has been used. In presenting this chart, it is realized that this relationship in volume of sales is no longer valid and that there has been a marked increase in premium sales with a concomitant reduction in the sale of third grade and housebrand fuels. However, since the current portion of the chart is primarily for the purpose of illustrating trends, no attempt has been made to correct the values on the basis of actual sales volumes.

Of particular interest is the rather remarkable regularity in increase in octane number that prevailed for the weighted average motor fuel (Figure 2) for the period from 1933 to 1941. The solid straight line projected through the actual octane number trend serves merely to illustrate the uniform manner in which increases occured at the rate of approximately 0.75 octane number per year for the average motor fuel. There are many reasons to believe that this definite and steady trend of rising octane numbers would have continued uninterrupted for some time had not wartime demands intervened to disrupt the normal course of developments that prevailed prewar. According to this hypothetical trend the octane number of 1945 and 1946 average gasolines would have been 75.9 and 76.6 had the war not intervened.

The effect of diverting large volumes of choice blending stocks from motor fuel consumption to the production of high octane number aviation fuels and 80 octane all purpose gasoline and of the many changes in refining practices and facilities made necessary to satisfy the petroleum requirements of our military services is evidenced by the sharp decline in octane numbers beginning early in 1941. It is of special interest to note (Figure 1) that at the end of the war octane numbers of premium motor fuels had declined to a level approaching that of housebrand fuels at the start of the emergency period.

The extent to which octane numbers of motor fuels will increase over prewar standards is still a matter for conjecture. That increases in the order of three to five octane numbers could well be achieved by the industry if necessary has been predicted solely on the basis of the added facilities and the advance in refining technology that have occured during the war. This would place the average motor fuel of early 1946 in the 77-79 octane number range. Merely as a guess, the dashed line of Figure 2 shows a probable trend of motor fuel octane numbers.

Whether the motor fuels of increased octane numbers as indicated by these graphs are necessary or desirable is another question. The cars now on the road were all on the road in 1941 and were then giving satisfactory performance with the motor fuels available at that time. Thus from the viewpoint of performance there appears to be very little justification for the higher octane number motor fuels.

*Reseach Department, Phillips Petroleum Co., Bartlesville, Oklahoma.

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Capital Sidelights on Oil

By W. J. Maddox, Chief of World Petroleum Washington Bureau

Pipe Line Question Unsolved

THE government seems to be no nearer a solution of what to do with the Big and Little Big Inch pipe lines than it was on V-J Day. Disposal of the lines is running true to predictions that their disposition would prove one of the government's knottiest surplus property problems. The Department of Justice's intimation that it would not look on operation of the lines by a group of companies as running counter to the anti-trust laws, provided a common-carrier status were maintained, has stirred little interest among oil companies.

Senator O'Mahoney, chairman of the special oil investigating committee, has obtained the approval of the Senate for 30 days' more time from the February 14 deadline for consideration of the Surplus Property Administration's pipe line report. The resolution now has to be approved by the House. Numerous persons opposed to the report have asked to be heard.

Evidence presented to the O'Mahoney committee pointed to the lines' conversation to natural gas carriers as most economical, but cool and railway interests squawked. There are bills in Congress calling for government operation of the big pipes.

Knifing in the Clinches

Seldom have Washington observers been afforded such an orgy of political blood-letting as that attending the hearings on Ed Pauley's nomination to be Undersecretary of Navy before the Senate Naval Affairs Committee. Knives long sheated were slipped more or less deftly into the ribs of old enemies. So grim and intense was the knife-flashing of the feudists paying off old scores that Pauley himself at times seemed just an innocent bystander.

Agree on Natural Rubber Price

A price of 20¼ cents a pound has been agreed on for standard top grades of natural rubber from British, Dutch and French areas in the Far East, delivered free on board ocean-going steamers at Far Eastern ports. Under terms of the agreement the RFC subsidiary, Rubber Development Corporation, will buy all rubber in those areas allocated to the United States by the combined rubber committee.

The agreement will cover the period Sept. 2, 1945 through June 30, 1946, in the case of the Dutch and the French, and the period Sept. 2, 1945 through March 31, 1946, in the case of the United Kingdom.

Back in November, the American-British-French-Dutch study group reported that the United States capacity for the production of synthetic rubber is now about 1,055,000 tons a year and that the estimated total world capacity is between 1,300,000 and 1,400,000 tons. Also, the board said U. S. manufacturing costs "have declined markedly in the recent past and are more than covered by the present selling price of 18½ U. S. cents per pound for general purpose synthetic rubber."

Asks Oil Price Ceiling Removal

B. A. Hardey, President of the Independent Petroleum Association, in the name of the independent producers, has called on War Mobilization and Reconversion Director Snyder to lift oil price ceilings, in line with his recent promise that ceilings "will be lifted as quickly as supply approaches balance with demand." Said Hardey:

"Since the war ended our supply does exceed demand and no shortage of oil is probable in the foreseeable future. No one disputes this fact. If price controls are continued, however, shortages might eventually be brought about. The oil producers must be encouraged to search more diligently for new fields. Every element of the industry has said so and the final words of the Petroleum Administration for War were in that vein. Such diligent search cannot be conducted unless a reasonable increase in the crude oil price is made. The OPA has refused for almost five years to pay attention to the increasing distress of domestic producers. It is time for this condition to be corrected."

Alaska Prospecting To Continue

NAVY'S award of a million dollar contract to three private construction companies for furthering its exploration of the Point Barrow petroleum reserve in northernmost Alaska during 1946 is just the first part of Navy's long-range program in Alaska that will carry possibly into 1950, if Congress provides additional funds to finonce the $11,500,000 project.

Announcement of the award was made by Naval Petroleum Reserves Director Commodore W. G. Greeman before his departure from Washington for an inspection of developments at the Elk Hills, California and Point Barrow reserves. The contract was awarded jointly to Hoover, Curtice, and Ruby, Inc., New York, mining and petroleum engineering construction managers; and C. F. Lytle Co. and the Green Construction Co., Des Moines, Iowa, general contractors.

The New York firm will be responsible for overall management, well-drilling and the geophysical phases of the exploration program, while the other two will provide camp maintenance, operation and freighting.

Navy's own exploration, confined to the eastern third of the reserve and done mainly with Seabee labor, has located one structure favorable to the accumulation of oil at Umiot Mountain. A test well 1,900 feet is being drilled further. Five separate oil-bearing sands have been encountered, none of commercial value. Navy says "several promising anomalies in the flat central plain between the Arctic Coast and foot-hills of the Brooks Range have been indicated from preliminary studies of the magnetic reconnaissance, while geophysical surveys have developed indications of a structure near the oil seepage area on Cape Simpson."

Minerals Inventory Proposed

PROPOSALS for an inventory of the Nation's mineral resources are finding a receptive ear in congress. Latest recommendation for such a project came down from the White House in the President,s annual budget message, but already there were two pieces of legislation, orginating in the Senate, going through the works, one sponsored by Senator Guffy and the other by Senator McCarran. "The depletion of our known deposits of critical and essential minerals during the war period," declared Truman, "demands that prompt steps be taken to inventory the nation's mineral resources, including an appraisal of the remaining undiscovered mineral reserve."

The Guffey proposal, S. Con. Res. 22, directs the Secretary of the Interior to report to Conress within six months on the minerals situation in the United States. It has passed the Senate and is now up to the House. The Secretary would be called on also to report "such other data as he may deem useful to the Congress in formulating a program for the making of the surveys, examinations, studies and investigations required to safeguard the nation's future security and economy by supplying the basic geological, technological and economic information needed to assist industry ond government in continuing program of exploration, conservation and development of the nation's mineral resources."

The President asked for more money for the Geological Survey, including nearly $2,500,000 for stepping up its program.

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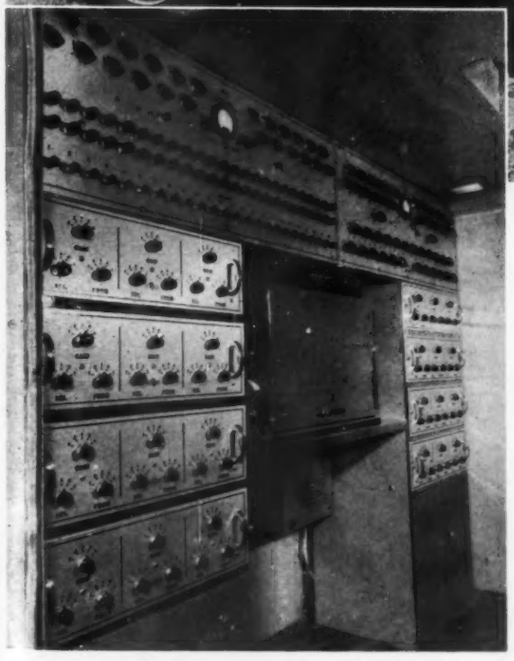

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Oil Company Staff Changes

Frank R. Markley

Maximilian H. Leister

FRANK R. MARKLEY has been appointed general sales manager of Sun Oil Company and will assist vice president Samuel B. Eckert. He formerly was manager of the company's industrial products department.

Maximilian H. Leister was made general manager of Sun's motor products department. He will supervise the sale of all motor products, including Dynafuel, motor oils, tires, batteries and accessories, and the operation of service stations and all advertising.

Ray H. Anders has been appointed to succeed Mr. Markley as manager of the industrial products department. Mr. Anders has been assistant manager of the department.

All three of the Sun Oil executives are veterans of company service who have worked their way up through the ranks.

E. D. LYNTON, research geologist for Standard of California, has been granted a two-year leave of absence to take charge of rehabilitation of the French oil industry for the French government. During the war Lynton worked with the United States Board of Economic Welfare. He was attached to the North African Economic Board, and spent two years in North Africa. He returned to the company in December, 1944.

Lynton, who was graduated from the Missouri School of Mines in 1912, started with Standard of California in 1920, after five years spent in mining and two years in the Navy in World War I. Since 1927 he has been active in geophysical research and making magnetometer surveys in California, Texas and Venezuela.

A. L. McCOLL has retired from the chairmanship of Vacuum Oil Co. Ltd. of London which he has held for the past ten years. Mr. McColl has long been active in British oil affairs, having joined Vacuum in early 1905. He became a director in 1919, deputy chairman in 1933 and chairman in January 1936. While relinquishing his executive duties, Mr. McColl will remain a member of the board of directors. His successor as chairman is A. L. Nickerson, a member of the board.

WILLIAM M. O'CONNOR, vice president of Atlantic Refining Company and general manager in charge of foreign production, died of a heart attack aboard a plane en route to Venezuela in January. He was deeply interested in the development of the company's operations in Latin America to which he had devoted his energies in recent years.

William M. O'Connor

WILLIAM C. FRYSINGER and John D. Kurtz have returned to their duties as executive in the foreign sales department of The Atlantic Refining Company after wartime service with the PAW. They had been stationed in Washington as assistant directors of the Foreign Supply and Distribution Division charged with helping expedite the shipment of petroleum products abroad.

Mr. Frysinger joined Atlantic in 1919, and was named manager of its subsidiary in Hamburg, Germany, in 1928. He left his post there and returned to this country in 1939. He was given leave of absence to enter war service for the Government in February, 1943.

Mr. Kurtz has been with the Company since 1928. Prior to the war he served abroad as assistant manager of the Atlantic subsidiaries in Germany and Belgium. He began his duties with PAW in August, 1941.

DONALD L. WRIGHT, a petroleum attache with the U. S. Embassy in London since 1943, has rejoined Standard Oil Company (New Jersey) in the marketing council department. The office of petroleum attache represented all U. S. civilian agencies for the wartime supply of petroleum products to the U. S. military forces in Europe and in contacts with British civilian and military organizations. In the marketing council department, a newly-formed group for the closer coordination of the company's world-wide marketing operations, Mr. Wright will handle sales engineering and product quality matters.

ISAAC DOUGHTEN, who resigned from government service last December, has returned to The Atlantic Refining Company as an executive in the foreign sales department. Mr. Doughten served as petroleum attache in Paris from March until November last year. Prior to that, during the war period, he held an important post in the petroleum division of the Foreign Economic Administration.

Isaac Doughten

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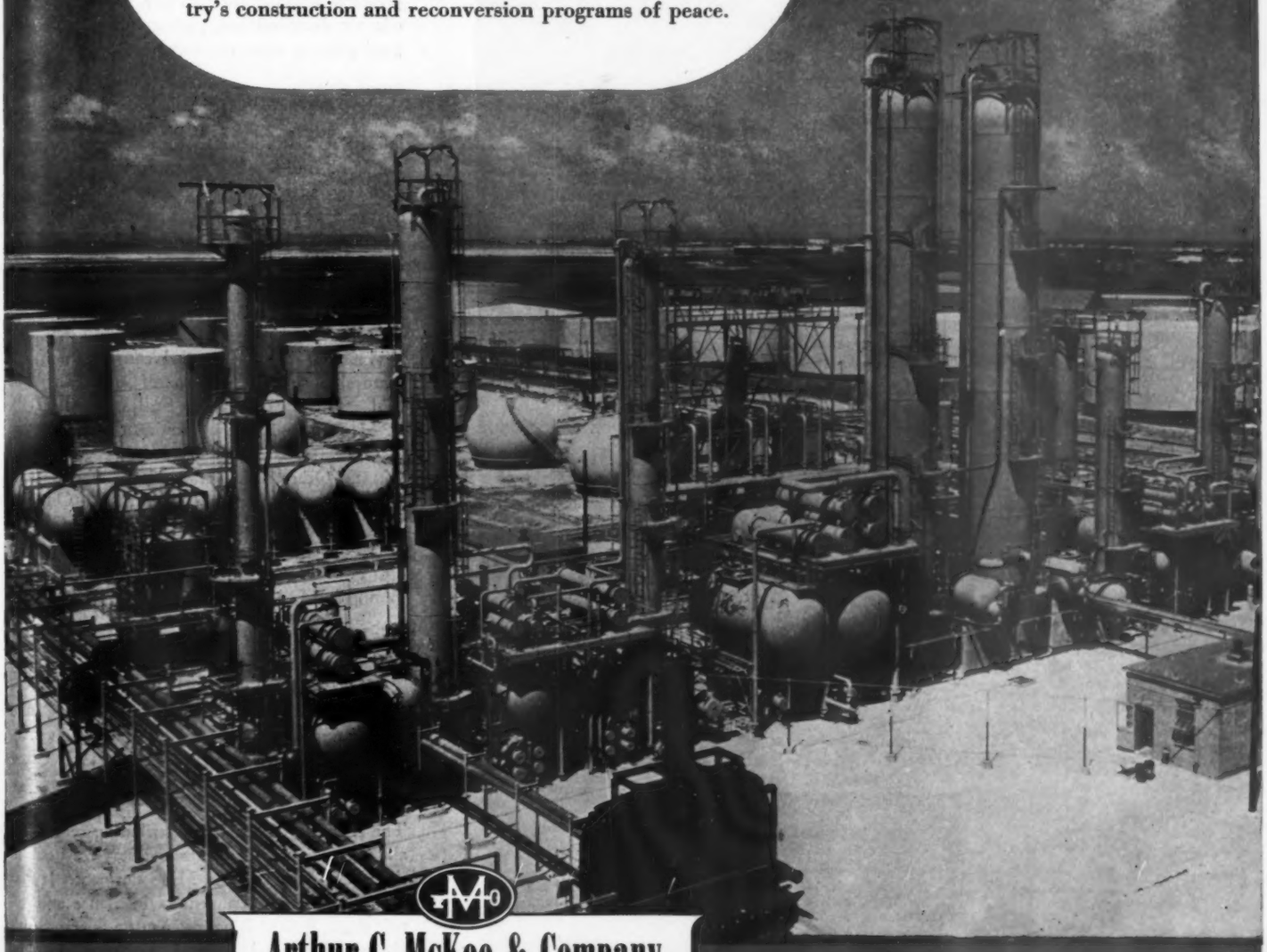

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Creole Maracaibo Manager

EDWARD EVERETT PEAKE has been appointed manager at Maracaibo, western division of Creole Petroleum, Venezuelan affiliate of Standard Oil (New Jersey). Mr. Peake was born at Churchland, Virginia, and was educated at the University of Richmond, Richmond, Virginia.

He came to Venezuela in 1927 with the Fitzsimmons Drilling Company, accepting a position with Creole the following year. In 1934 he was made superintendent in Lagunillas and in 1938, he was made superintendent at La Salina, which post he held until 1944. This year he was named assistant manager, then manager of Creole's western division, which territory includes the Maracaibo basin. Mr. Peake is being replaced at La Salina by Chester L. Babin, formerly manager of Creole's central division.

Builds Cycling Plant

ON the west bank of the Mississippi River, just opposite Natchez, Miss., The California Company is beginning construction of a cycling plant to increase recovery from its Lake St. John field, in Tensas and Concordia Parishes, La. The plant will have a throughout capacity of 100 million cubic feet per day. The Hudson Engineering Corporation is the contractor in charge of design and construction.

All the productive area and horizons involved will be unitized, and the most distinctive feature of the operation is the fact that the oil production is being pooled with the condensate production for the unitized portion of the field.

The possibility of constructing a similar plant on the east side of the Mississippi River, near Natchez, to take care of The California Company's Cranfield Field, in Mississippi, is receiving consideration.

Hortonsphere Booklet

A new six-page booklet "The Hortonsphere" has been published by the Chicago Bridge & Iron Company, to describe the reduction of evaporation losses from highly volatile liquids by storing them under pressure. The correct storage pressure required to prevent standing losses from volatile liquids can be read directly from the chart shown in this booklet. Included is a standard capacity table showing the operating pressures available for each size. Gauging methods are described and photographs of three typical gauging units are shown.

Opens Detroit Office

TUBE TURNS, INC., has opened offices in the Ford Building at Detroit. Jack Ellsworth, formerly assistant manager at Chicago, is in charge. The new Detroit territory will include Michigan and parts of Ohio, Indiana and Illinois.

N.G.A.A. Convention Planned

TWENTY-FIFTH annual convention of the Natural Gasoline Association of America will be held at the Baker Hotel, Dallas, April 17-19. P. M. Raigorodsky, vice president of Glen Rose Gasoline Co. is chairman of the program committee. Other members are J. B. Atkins, The Parade Co., H. W. Manley, Barnsdall Oil Co.; Frank Matheney, Phillips Petroleum Co.; I. Earl Nutter, Hagy, Harrington & Marsh; Robert T. Wilson, La Gloria Corp. and W. E. Winn, Sun Oil Co.

Sperry-Sun Buys Houston Property

THE SPERRY-SUN WELL SURVEYING COMPANY has purchased the building and two-acre property at 3118 Blodget Avenue, Houston, Texas, on which its present Gulf Coast headquarters are located.

The Houston office is the distributing center for all Sperry-Sun instruments and services used in the Gulf Coast and the Mid-Continent. It has a well-equipped instrument maintenance and repair shop. Roland Ring, assistant to Sperry-Sun's vice-president and general manager, G. L. Kothny, is in charge.

Sperry-Sun is also establishing a new research and development department in the suburbs of Philadlphia where new equipment and new services will be developed and tested.

Gowdy Rejoins Wyatt

J. S. GOWDY, for the past 38 months with the Seabees, has returned to the Wyatt Metal & Boiler Works at Houston to become purchasing agent. He replaces C. L. Williams who has left the company to enter business for himself. Prior to joining the Seabees, Mr. Gowdy was connected with Wyatt sales and production departments. He is a graduate of Cornell University and has had a broad experience in the general engineering field.

Glasgow Engineer Honored

A. P. NEWALL, chairman and managing director of Messrs. A. P. Newall Co. Ltd., Woodside Engineering Works, Possilpark, Glasgow, recently was presented with an illuminated address and silver sea-tray by the British Nut and Bolt Industry as a spontaneous contribution to the industry over many years.

The presentation was made by Major C. R. Dibben, Independent Chairman of the various British Bolt and Nut Manufacturers' Associations, and he was accompanied by Mr. G. F. V. Richards, Deputy Chairman of The Black Bolt and Nut Manufacturers' Association of Great Britain.

Mr. Newall's home at Perryston, Ayr, was the scene of the presentation and a very personal touch was added by the handing over of a gift to Mrs. Newall.

K. Symes Retires

THE YORKSHIRE COPPER WORKS LTD., announced that K. Symes, manager for many years of the London office, retired on December 31st and his place is being taken by Kenneth Billinge, who has been associated with the company for many years. Mr. Symes remains on the Board.

Cooper-Bessemer Expands for South American Trade

ESTABLISHMENT of a branch office in Caracas, Venezuela, to serve expanding markets in that country, Colombia and Peru, is announced by M. C. Pollock, vice president in charge of export sales for The Cooper Bessemer Corp. with plants at Mount Vernon, Ohio, and Grove City, Pa. A survey of South American markets completed recently by Mr. Pollock indicated a growing demand there for Diesel engines and engine driven compressors.

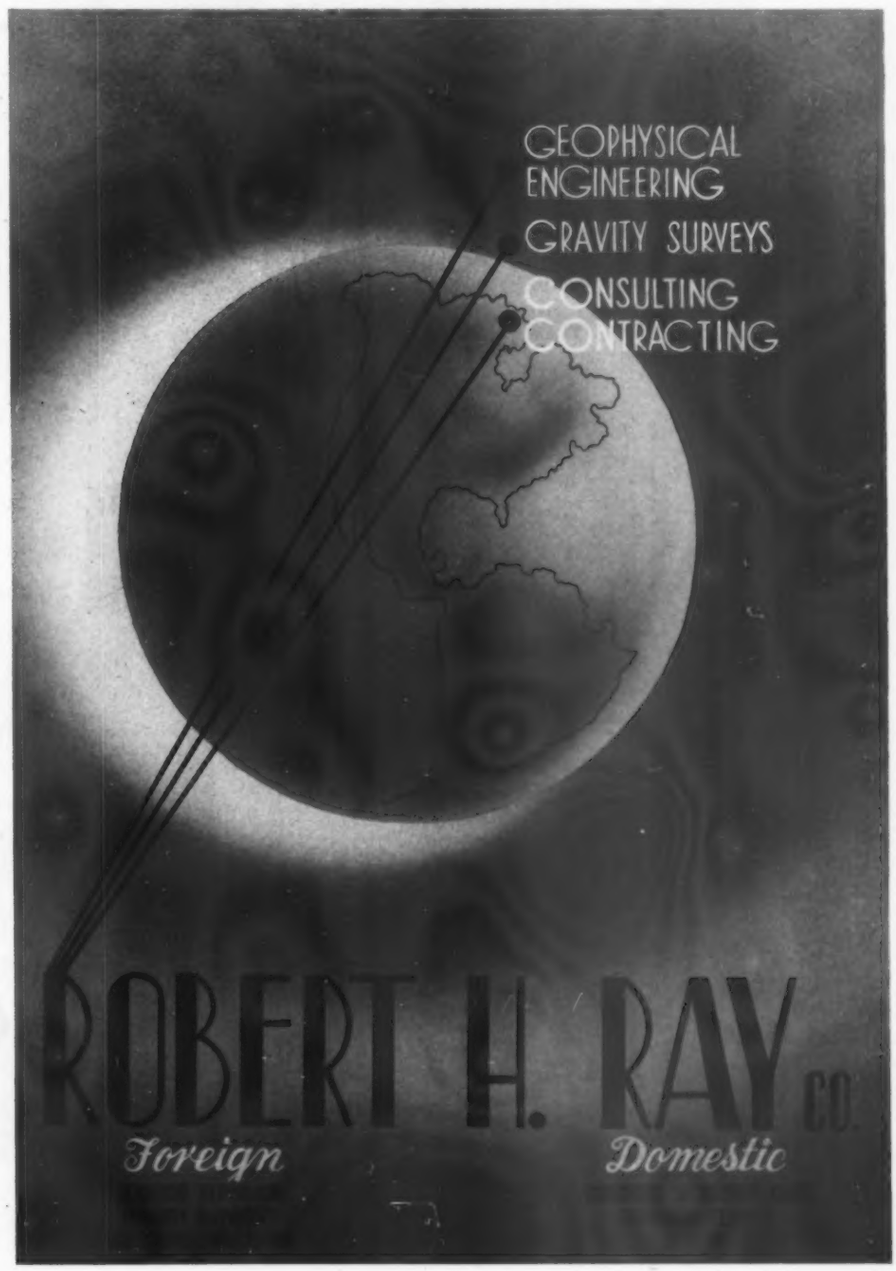
Thomas E. Kraner has been appointed branch manager in charge of the new South American headquarters. Mr. Kraner, a graduate of Purdue University, has been affiliated with Cooper-Bessemer since 1937 and has been with its Washington office for the past six years.

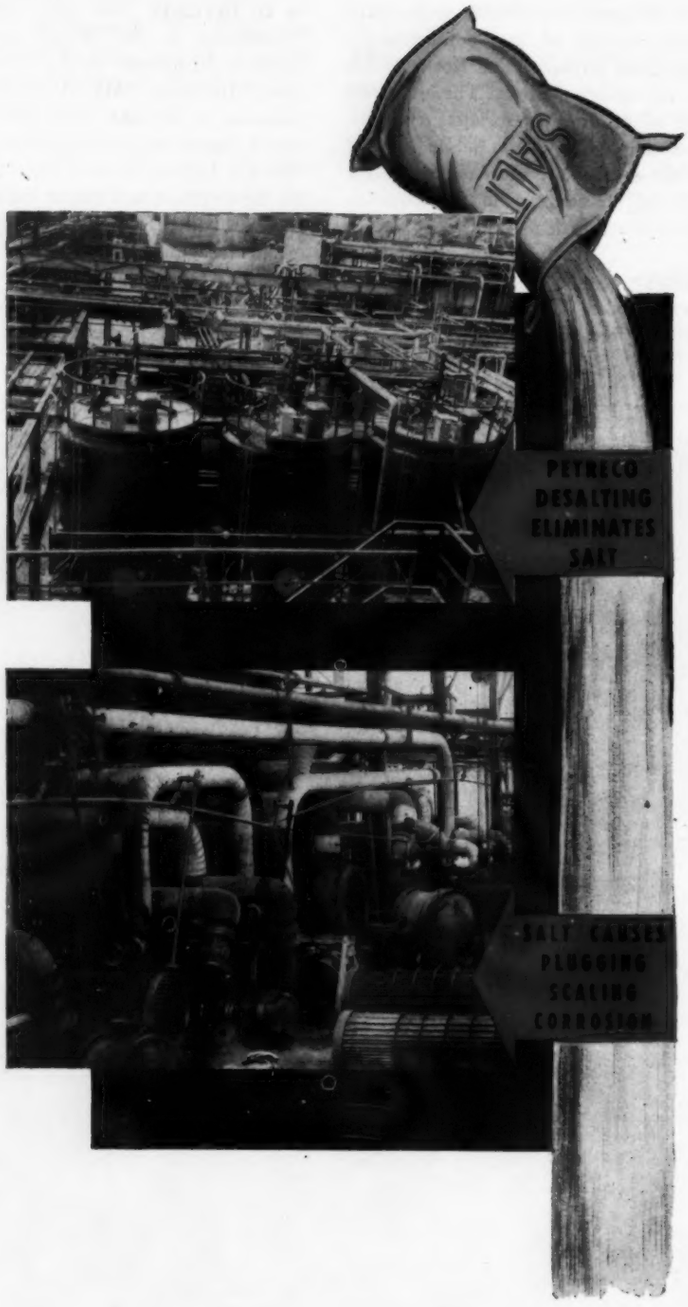
Roadable Airplane

A NEW type combination automobile and airplane called the Roadable, has been experimentally built, test flown and road tested by Southern Aircraft, manufacturers of the "Southernaire", de luxe corporation airplane. The Roadable has conventional automobile controls. The brake and clutch pedals adapt for use as rudder controls, while the steering wheel operates ailerons and elevators while in the air. Roadable is purely experimental and the company has no intention of going into production at this time.

W. R. "FROSTY" MARTIN has sold his interest in Martin-Decker Corporation to E. L. Decker who now becomes a president and sole owner. Mr. Martin is 75 and has been in oil since he helped pump his father's wells in Pennsylvania at the age of eight.

M. H. ARVESON has been appointed senior technologist in the recently formed chemical products department of the Standard Oil Company (Indiana). Mr. Arveson has been with Standard of Indiana since 1927, first as a research chemist and group leader at the Whiting Refinery laboratories and later as a member of the development and patent department. Dr. E. L. D'Ouville, formerly a member of the research department, has returned to Standard of Indiana after several years with the Mellon Institute and will take over Mr. Arveson's present duties in the development and patent department.





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Instrument Bulletin

A 64-page bulletin describing its line of industrial and scientific instruments has been issued by Negretti and Zambra, 122 Regent St., London, W 1. The list of instruments extends from simple mercury thermometers through a comprehensive range of indicating and recording instruments to completely engineered control schemes involving the use of a number of inter-related instruments and fully stablized controllers. Instruments as described are available in either Centigrade or Fahrenheit scales and English or metric readings.

Steam Generator Brochure

MITCHELL ENGINEERING Ltd., has published a new steam generator catalog which contains much data selected for its usefulness to those interested in modern steam generating practice. Copies of the brochure are available, post free, on application to IEDA Publications Department, Stanground, Peterborough, England.

Rees Joins Patterson-Ballagh

EARL REES has joined Patterson-Ballagh as California representative. He will make his headquarters at the factory at Los Angeles. Mr. Rees has just returned from four years in the Marines in which he served as Captain. Before the war he was with Republic Supply Company of California, Fluid Packed Pump Company and Oil Well Manufacturing Company.

To Train Turkish Drillers

H. V. HUEPPELSHEUSER of the George E. Failing Supply Co., is enroute to Turkey where he will train drilling crews. The Turkish government is undertaking an extensive program of exploration for oil and water bearing sands. Eleven portable drilling rigs are being sent by Failing for the campaign.

Enters Drilling Field

JOHN O. FARMER has resigned as sales manager for Otis Pressure Control, Inc., to enter the drilling contractor business as a partner of Jones and Shelbourne. The new firm will operate under the name, Jones, Shelbourne, and Farmer, with the latter in charge of field operations in Oklahoma, Kansas, and Montana.

Mr. Farmer served with the Otis organization for 13 years. Previously he served as junior engineer for the Carter Oil Company.

Changes in Attapulgus

WILLIAM A. EDSALL, for many years vice president in charge of sales of the Attapulgus Clay Company, has retired. He will be succeeded by Robert H. Hubbell, Jr. Announcement was also made that William S. W. McCarter had been named technical director of the company, succeeding Mr. Hubbell.

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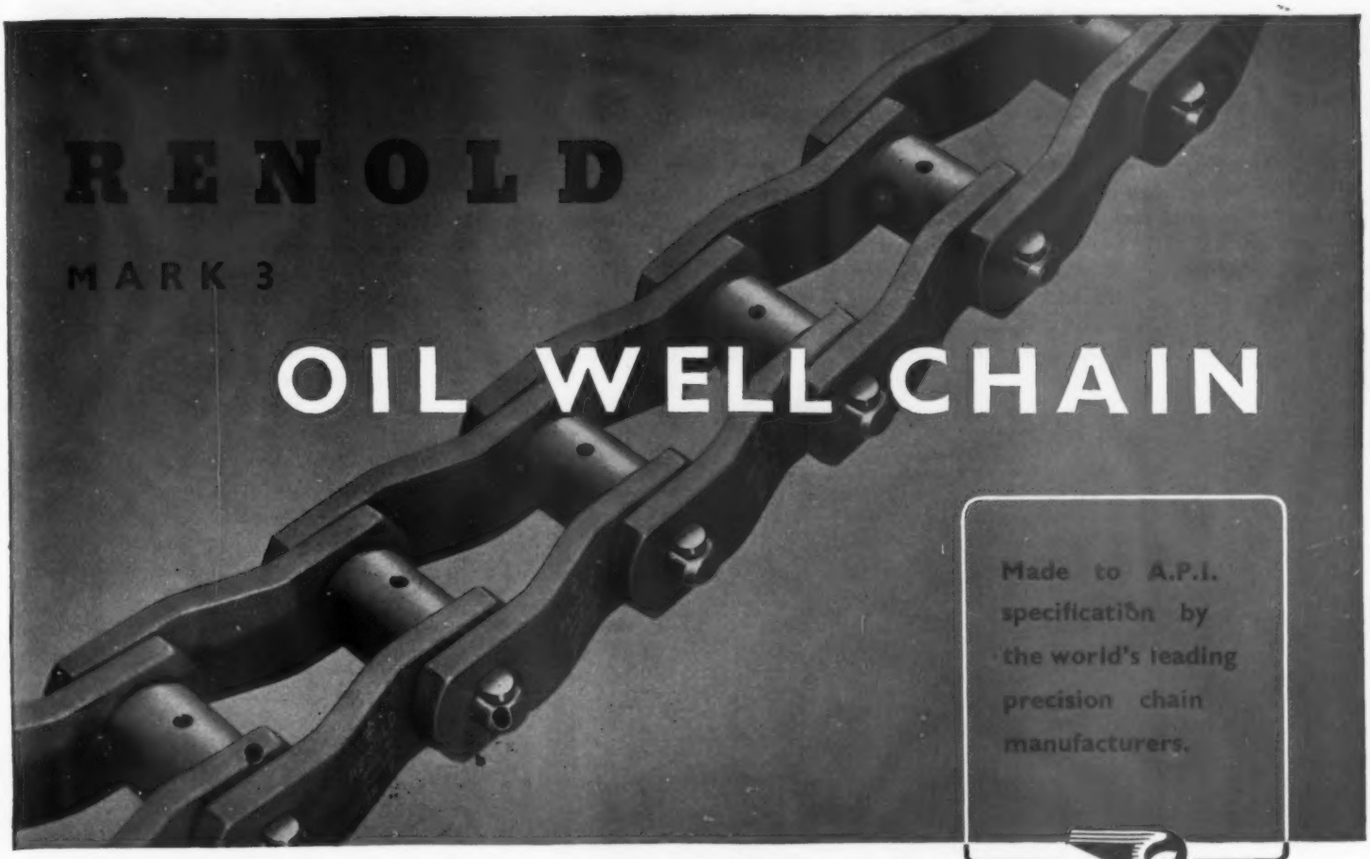

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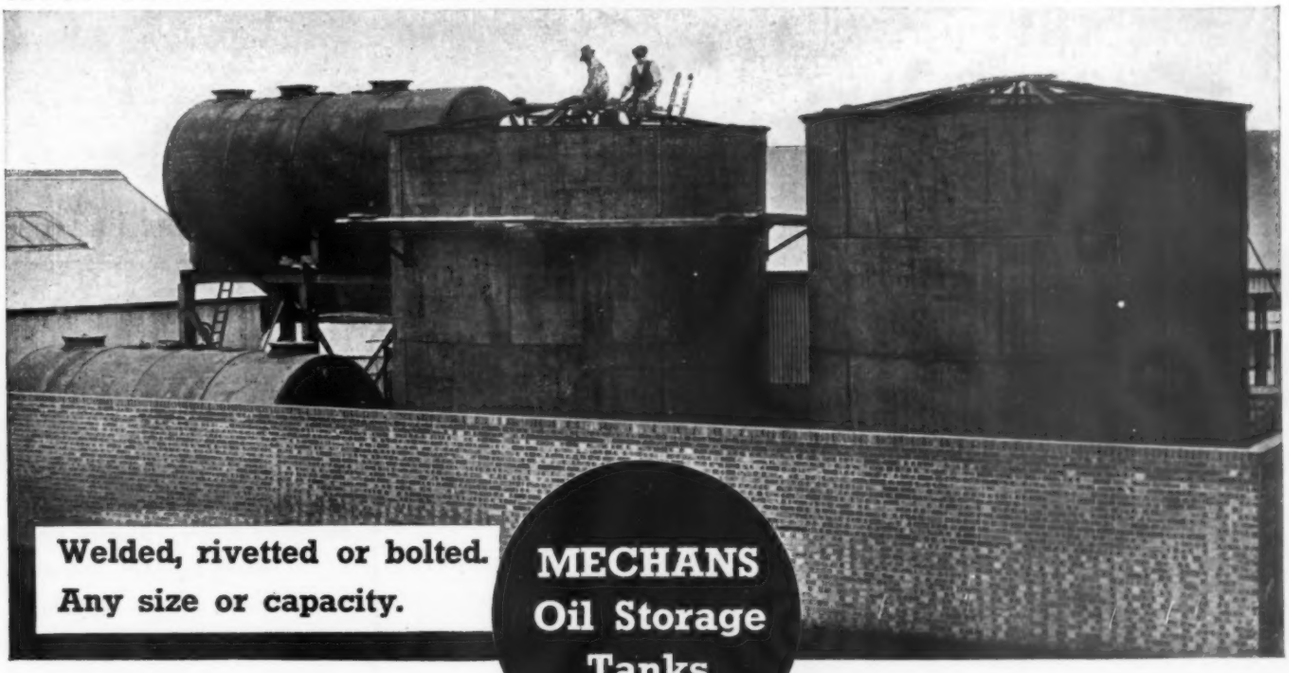
ILLUSTRATION SHOWS TANKS DURING ERECTION AT OIL SERVICE STATION



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Venezuela Production Sets New Record in 1945

(*Continued from page 64*)

in the Delta Amacuro. A large central camp containing 35 family houses, and now nearing completion, has been constructed on the western outskirts of Maracaibo, a project admittedly courageous for a company not yet producing oil.

The Consolidated Oil Co. will confine its 1946 activities largely to development drilling in the Santa Barbara field of Mongas and exploratory drilling in nearby areas.

Venezuelan Atlantic plans to drill at least seven exploratory wells during 1946, mostly in Northern Monagas on lands covered by the Pantepec-Atlantic contract of 1944. Three seismograph parties, one gravimeter party and one or two surface geological parties will carry out surveys in the states of Monagas, Anzoategui, and Guarico.

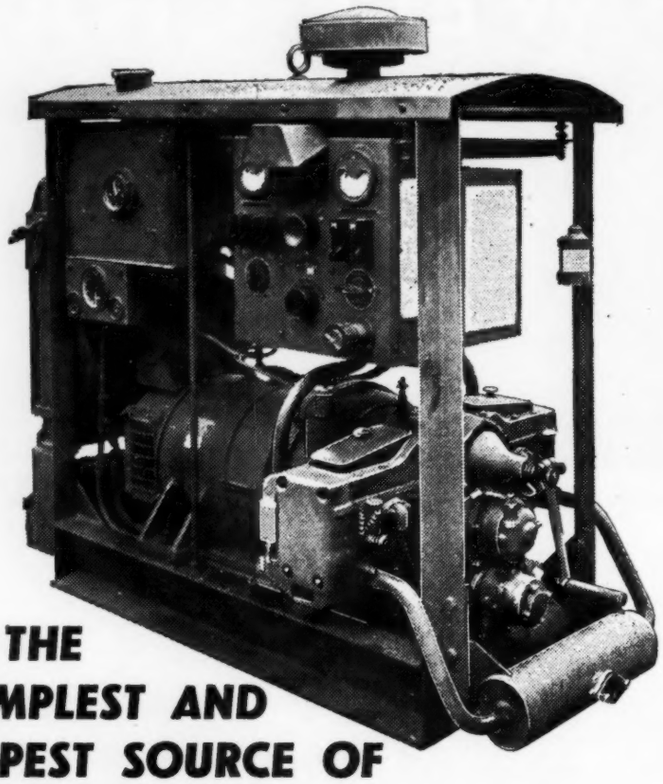
North Venezuelan Petroleum Co. will continue the geologic study of its 988,400-acre holdings in Falcon but no drilling for 1946.

As increased production was the immediate result of increased demand in 1945, so also was the tremendous construction program. Some new camps were built while others were enlarged and improved. Garages, offices buildings, and warehouses were constructed. Such utilities as gas, water, plumbing and light had to be provided. Pipe lines were laid; roads were built and bettered, and in some areas, new airports established. Added to these was the usual replacement of equipment in refineries and other industrial units. Since lack of materials is always a concomitant of war, some projects were begun but not completed.

The construction program which was inaugurated in 1945 will be continued in 1946.

New S. O. California Subsidiary

THROUGH its subsidiary, The California Company, Standard Oil Company of California has incorporated a new marketing company to be called The California Oil Company, with headquarters in Barber, New Jersey. The new subsidiary will take over the eastern marketing activities of The California Company. These consists principally of the distribution of special lubricating oils, which The California Company has marketed in the East for many years, and a relatively small volume of gasoline which had been placed in the East for some years prior to the war. All the new company's sales will be to jobbers.



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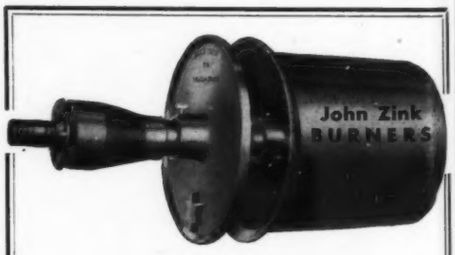

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Estimates free. Ask the nearest Dowell office or station about: Mud Acid Service, Water Locating, Acidizing, Electric Pilot Service—Jelflake and Jelfoam, Paraffin Solvents and Inhibited Hydrochloric Acid.

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Well producing from Frio formation, bottom-hole temperature 232°. Before Dowell Plastic was used at depth of 7977 feet, well was producing 90% brine, 10% oil. After treatment—no brine, 100% oil. Hundreds of similar cases available in Dowell files.

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Geologic Structure of North Florida Province

(*Continued from page 46*)

Oil fields on two sides of the North Florida Province indicate that the conditions necessary for the formation, migration and trapping of oil exist in this area. A study of all the available evidence convinces one that structures do exist in this area, that oil fields will be found in the forthcoming development and that they will be good oil fields.

This province represents one of the most attractive "new" areas left for companies to prospect in, and is now on the threshold of an active wildcatting program by the major companies, which will represent its first thorough exploration. Prices are still low, value considered and compared to other areas and this is destined to be an area of rising prices for several years to come.

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Award of Merit to Col. Hird

LT. COL. ROBERT W. HIRD, until recently, on leave from Continental Oil Company, received the Army's Legion of Merit award just before leaving the service. The award was given for outstanding service in development of the famous "weasel" officially known as Cargo Carrier M29C. Hird is the son of Captain Willard F. Hird, division manager for Continental at Lincoln, Nebraska. He returned to the Continental marketing department in December.

Colonel Hird is an engineering graduate of the University of Nebraska. He was a reserve officer before the war and immediately after Pearl Harbor was called to the Chief of Staffs office in Washington as a First Lieutenant. He was promoted steadily through the war as a result of his work at Aberdeen and as contact man from the Chief of Staff's office with various manufacturers making many types of secret weapons.

Pittsburgh Equitable Name Changed

PITTSBURGH EQUITABLE METER CO. has changed its name to the Rockwell Manufacturing Company in honor of Col. Willard F. Rockwell, president and chairman of the board. The Pittsburgh Equitable Meter Co. name will not disappear, however. It is to be continued as a subsidiary to market measuring equipment. Another name change in the Rockwell group of companies will be from Merco Nordstrom Valve Company to Nordstrom Valve Company.

Other Rockwell companies include Rockwell Machine Co., Hopewell, N. J.; The Edward Valve & Manufacturing Co., East Chicago, Ind.; The Delta Manufacturing Co., Milwaukee; The V & O Press Company, Hudson, N. Y.; The Crescent Machine Co., Leetonia, Ohio; Rockwell International Corporation, New York; and Monessen Foundry & Machine Company, Monessen, Pa.